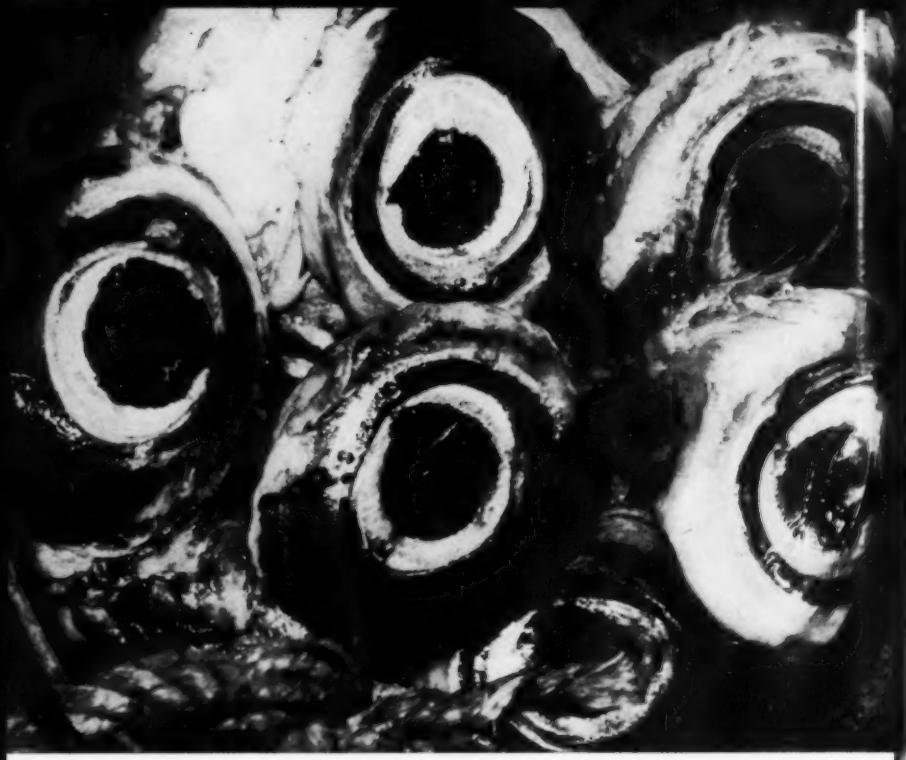
Sea Frontiers

Bulletin of the INTERNATIONAL OCEANOGRAPHIC FOUNDATION

February, 1960 Volume 6, No. 1



MODERN ART? *In spite of its appearance, this is simply a bucketful of eyes from giant bluefin tuna, collected during the International Tuna Match, at Cat Cay, Bahamas. The eyes were rushed under refrigeration to laboratories making special studies of the retina. This is one of the ways sports fishermen members are aiding science. (Thornton, Bahamas News Bureau)*

FRONT COVER. THE SILENT "BELLBUOY." *Increased use of radar equipment, even on board small craft, makes an unlighted and soundless navigational aid practical. The metal vanes at the top of this experimental model reflect a strong echo which forms a well marked "pip" on the radar grids of approaching ships, during fair weather or foul. The buoy requires little servicing, except an occasional haulout to remove barnacles and other marine growth. (U. S. Coast Guard)*

BACK COVER. GALLEONS OF SPAIN *once used the ramparts of El Morro as a navigational landmark when approaching the harbor of San Juan, Puerto Rico. Today the island plays its part in marine research through the Marine Laboratory at Mayaguez. Its team of game fishermen won international honors at Cat Cay, Bahamas, in 1959. (Pan American World Airways)*

SEA FRONTIERS

Bulletin of the INTERNATIONAL OCEANOGRAPHIC FOUNDATION

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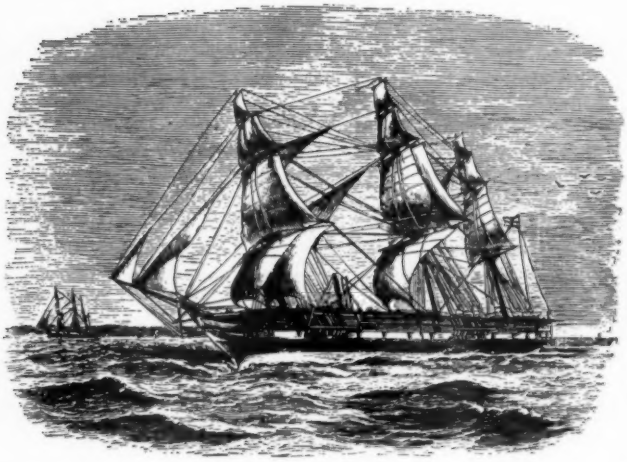

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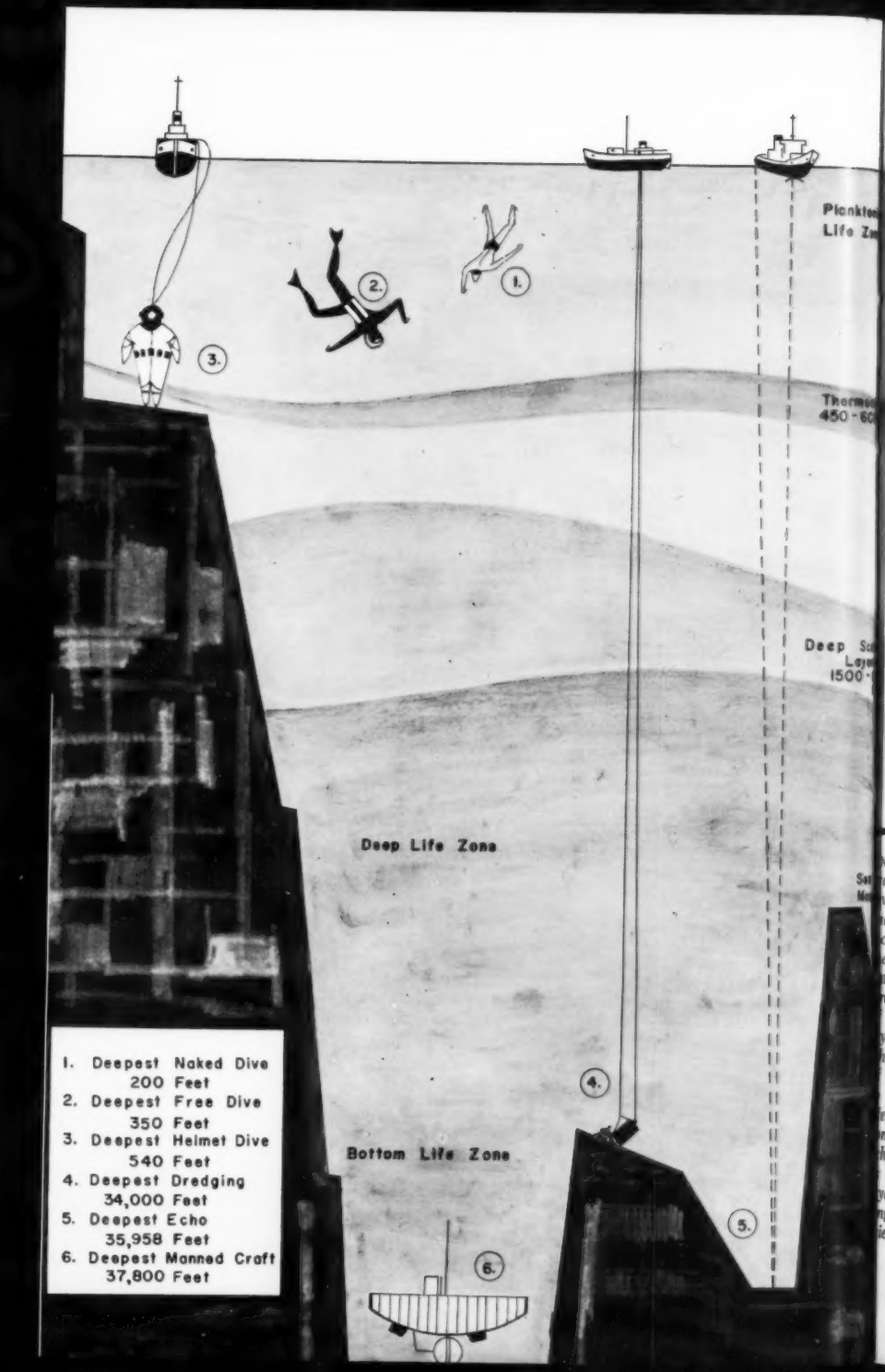
Deep Life Zone
Bottom Life Zone
1. Deepest Naked Dive
200 Feet
2. Deepest Free Dive
350 Feet
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540 Feet
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37,800 Feet

Report to Members

DURING the past year rockets and man-made satellites have raced round the earth in orbits of varying description and Russian ingenuity has, apparently, succeeded in obtaining more information about the hidden side of the moon than we have about many parts of the deep ocean. Nevertheless, as members may have noticed, there has been a definite growth of public interest in the science of the sea and of the oceans, in which most of the remaining unexplored parts of the earth still await investigation.

Members may take some pride in the part played by the Foundation in helping to focus attention on the scientific study of the sea. Although still a young and inadequately financed organization, it has extended its activities to the limit of its resources. Most obvious, of course, is the continued publication of up-to-date and authoritative articles by marine scientists and others in *Sea Frontiers*.

XPLORATION OF THE DEPTHS. *This diammatic progress report (not to scale) veals some of the "lows," approximate d actual, reached to date. It also incates, through a last-minute alteration, e record dive of the U. S. Navy's thyscaphe* Trieste *in the Marianas rench, January 23, 1960. By the use shading, the artist shows the various yers and life zones of the open sea. he thermocline, for instance, is a layer rapid temperature change important submarine detection and to marine e. Deep scattering layers are really ncentrations of plankton, causing hoes on sounding devices, once known the "false bottom." Little explored yers and zones present intriguing chalnges to present and future marine ientists. (Drawing by Richard Marra)*

Revealing a New World

Perhaps the most ambitious of the projects described during the past year is MOHO, the proposed probe through the deep sea floor to the foundations of the earth's crust. Other articles have disclosed some of the exciting things taking place in marine laboratories from Curaçao to Vancouver or Scotland, and on board the large ships now being used for ocean study by the Russians. The scientific basis of the mermaid myth, the mystery of the disappearing West Indian seal, strange deep sea monsters, how whale meat was used to destroy cattle parasites and how the age of mankind is measured by deep sea sediments were included in the wide range of topics.

A total of over 180 illustrations pictured such odd sea creatures as the "fish that wears a nightgown" and the sea serpent that is a fish. "Gold in Them Thar Waves" revealed the sea as a present and future source of valuable minerals, and other pertinent articles covered conservation of marine resources.

Sea Puzzles Await Solution

From a world-wide viewpoint, reports on the first International Oceanographic Congress provided a focal point for the efforts now being made to bring adequate scientific effort to the puzzles of the sea, from the vag-

aries of ocean currents and hurricanes, to the origin of life itself.

Sea Secrets, the newsletter and question-and-answer service, has been mailed to schools and libraries as well as to members. This service is provided at cost to schools which apply. The illustrated booklet on the new world of sea science, *Turn to the Sea* by life member Athelstan Spilhaus, was also sent to all members, in cooperation with the publishers, the National Academy of Science.

A considerable number of the booklets *Hints for Sailors,* predicting ocean currents in the Gulf of Mexico and southeastern United States area, was mailed in response to requests from fishermen, anglers and yachtsmen. The growth of interest engendered by these publications was indicated by membership growth to almost exactly double that which existed at the beginning of the year. In fact, *Sea Frontiers'* circulation has doubled each year since its birth in November, 1954.

Student Scholarship

Of even more direct aid to education was the establishment of a scholarship for marine biology students who qualify by practical experience in fishing, or through belonging to the family of a commercial fisherman or guide. One student has already been approved and is now collecting at sea off New Zealand as part of an expedition financed by member Edwin J. Gould.

Another fund, established through the generosity of member Tyson H. Lykes, has made possible the purchase of about $15,000 worth of scientific equipment, including spectroscopic instruments for analyzing ocean sediments and the tissues of marine life, and an instrument for precise recording of ocean depths.

Grants to support research were continued as in previous years and financial help was also given to help defray travelling expenses of distinguished scientists to the International Oceanographic Congress.

Field Station at Hatteras

The annual Game Fish Research Conference was held in Nassau, Bahamas, in November, 1959, and was well attended by anglers, charterboatmen, ichthyologists and others. Of additional interest to anglers will be the appointment of a committee to consider the erection of a small laboratory or field station at Hatteras, North Carolina, where large catches of marlin are being made from the Hatteras Marlin Club.

The museum committee has now drawn together some tentative plans for a modern museum of marine science. This would incorporate electronic and mechanical moving models, modern lighting and sound devices to bring to both grown ups and children an exciting explanation of all aspects of the sea, from the forces which set the great currents in motion to the sun-given energy which indirectly, through a food chain of small and large creatures, ends up in our fish catches. Simulated bathyscaphe dives in various parts of the world's oceans and working models of submarine detecting gear are included

OCEANOGRAPHY'S FUTURE *holds many exciting possibilities. While this drawing depicts an imaginary mining operation in the deep sea, it may not be so farfetched as it appears. But much more progress in the* basic scientific knowledge *of the oceans is necessary to bring it, and other practical marine ventures, to reality. The Foundation supports such oceanic research through scholarships, research grants, and meetings of scientists. (Courtesy Vanadium Corporation)*

in these imaginative plans. Considerably more work is involved, however, before the plans can be made a reality.

What is to Come?

Looking ahead, *Sea Frontiers*' editorial staff has in preparation articles on a variety of timely subjects, including manned buoys which will float free on the open sea, the movement of continents, a spear-fishing snail, miniature monsters of the depths, how game fishermen aid scientists, the way in which fish behavior may be related to humans, rare fishes of the remote Seychelles Islands and several articles on the subject of sea shells which should interest collectors.

Members, too, can play a vital part

in the achievement of our scientific objectives. For instance, at the moment, three expeditions are being planned by members Edwin J. Gould, Barclay Warburton and W. T. Stuart, to New Zealand, the western Indian Ocean and round the world respectively.

Those who stay at home can also help. By increasing membership it will be possible also to achieve the worthy objective of making *Sea Frontiers* a monthly full-color magazine. Sample copies will gladly be sent to friends whose addresses are mailed to the Editor, or new members may be directly nominated.

Many Gift Memberhips

During the past year, growth in membership benefited greatly, both by nominations and through a large number of gift memberships made at Christmas or on the occasion of birthdays. For industrial corporations which are directly or indirectly interested in the objectives of the Foundation a corporate membership is provided. In many cases the tax laws provide gifts to be income tax deductible.

One last item deserves mention. The Board of Trustees at the annual meeting voted an award, to be given to an angler or game fisherman who has contributed in an outstanding fashion, either financially or otherwise, to the advancement of marine science. The form of this award has not yet been decided. However, it will be a fitting recognition of the substantial help that many anglers have already given to scientific research.

Woman Guides Navy Ships

Old Navy hands consider a woman on board a warship as an omen of bad luck. But today's skippers are very glad to steer their ships along courses plotted by a shore-bound woman oceanographer. The U.S. Pacific fleet has saved fuel, time and discomfort as a result of the calculations of Comdr. Margaret McGroarty, a Wave and trained weather observer, who is attached to the Alameda Naval Air Station. A similar weather service is now available also at Norfolk, Va. Studies of 126 voyages using the new facilities reveal that an average of 16 hours and 55 minutes have been saved on each ocean crossing, by changing course in accordance with changing weather conditions.

Ocean tracks formerly were based on average seasonal conditions. Now oceanographers use the Navy's own high-altitude air samplings, and the Weather Bureau's thirty-day and five-day forecasts, and apply the data to obtain possible wave height and direction.

Currents and islands also play roles in determining the "initially recommended route," which is altered by radio as unpredicted weather changes develop.

CAPTAIN JACQUES-YVES COUSTEAU *supervises the handling of the jet-propelled Diving Saucer. The turtle-like device, successfully tested off Puerto Rico recently, will meet the need for a highly maneuverable craft to carry man on down below 350 feet, the maximum limit of aqualungs. Scientists thus will be able to explore more thoroughly a whole new realm, down to about 1,000 feet. (© National Geographic Society)*

And Now the Diving Saucer

By E. JOHN LONG

UNDERWATER JET PROPULSION is nothing new. For untold centuries the squid, the octopus and other sea creatures have propelled themselves by forcing out a powerful water stream, achieving fairly rapid speed for short distances.

Surface movement of ships by water jet goes back to experiments during the days of the ancient Greeks, and today a number of craft employ the principle, turning or reversing the water jet nozzle to change direction or even to come to a halt. Waterjet devices have been installed in a new British ocean liner, to assist the ship in docking or maneuvering in narrow channels.

But a jet-powered *diving* saucer is something else again. Now that one has been successfully tested off Puerto Rico, it is expected that new frontiers will be opened to underseas explorers.

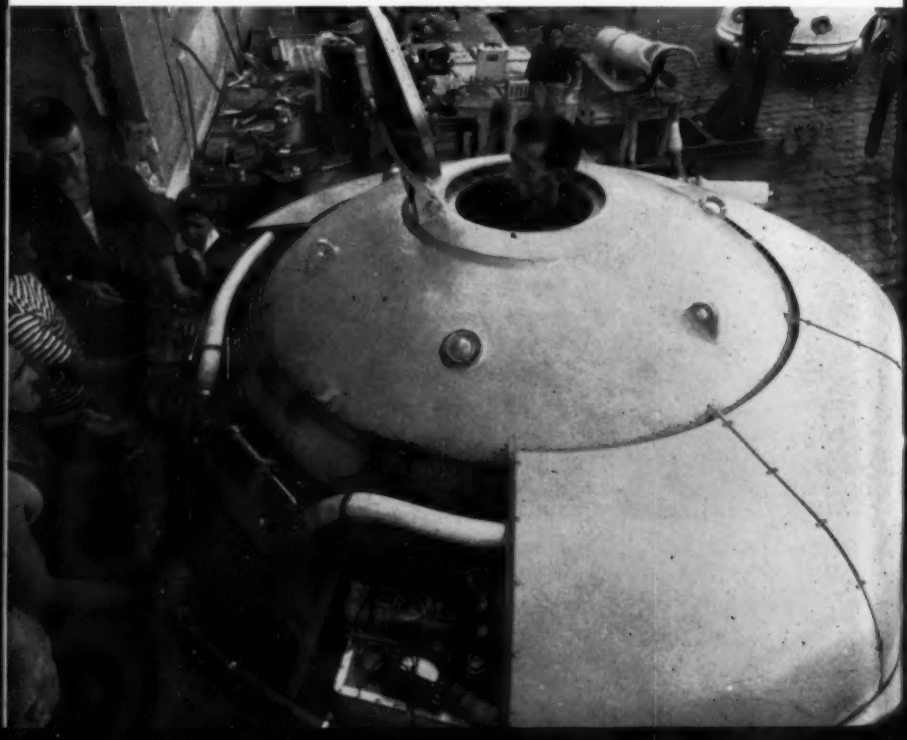
Designed by Captain Jacques-Yves Cousteau, co-inventor of the aqualung, this man - made sea monster looks like a huge mechanical turtle with two gaping porthole eyes. No mere freak or novelty, the vehicle is expected to meet the need for a highly maneuverable device to carry men on down below 350 feet—the maximum depth of divers equipped with aqualungs.

Shown at Oceanographic Congress

The French Undersea Research Center, at Marseilles, constructed the saucer with aid from the National Geographic Society, Washington, D.C. It was displayed at the International Oceanographic Congress in New York, in September, 1959, and later shown to scientists at Washington.

No operational tests were made, however, until its mother ship, the *Calypso*, reached Puerto Rico. On

A CREWMAN DEMONSTRATES *how the top hatch of the Diving Saucer operates. Part of the outer hull has been removed to expose the machinery and equipment. Underwater, the pilot can direct the ship up, right or left, or down, aiming his porthole camera as a fighter pilot does his gun. Propulsion comes from two water jets. (© National Geographic Society)*



October 10, 1959, underwater pilot Albert Falco and engineer-constructor Jean Mollard took the diving saucer on a 95-minute free dive. They reported that its power system, relays and instruments functioned perfectly, and that the vehicle was "very stable, fairly fast, and extremely maneuverable." Mr. Falco added the steering system was so responsive that he felt himself checked out as a diving saucer pilot after one dive.

Although large in comparison to most fish, the saucer has modest dimensions, being only 6.5 feet in diameter and five feet high. It has a thin steel hull, with a top hatch which can be easily opened. Pilot and observer lie on a rubber mattress and peer out at the passing panorama of sea life through Plexiglass ports. Another and smaller port accommodates a motion picture camera. The pilot can direct the ship up, right or left, or down, aiming the camera as a fighter pilot does his gun. Propulsion comes from two water jets.

Maze of Instruments

The interior of the saucer resembles an almost continuous instrument panel. Included are a gyrocompass, automatic pilot, jet control, rudders, camera controls, depth gauge, and manuals for a hydraulic claw on the outside. The latter can collect specimens of marine life, such as corals shells and sponges.

The turtle-like vehicle will be used chiefly along the continental shelf, one of the richest and most interesting sectors of the vast undersea world. Along the Atlantic side of North America this little-known offshore province stretches out to what is known as the "dropoff line," a boundary some 600 feet in depth. From the dropoff line the continental slope plunges sharply to the abyss, or floor of the ocean. The saucer can descend about 1,000 feet along this cliff-like slope.

DANCE MACABRE. *Octopuses in a tank carry out one of their weird maneuvers, moving with the aid of water jets. A similar principle drives the new Diving Saucer. The jet exhaust pipe of the upper octopus can be seen just below the creature's eyes. (Marine Studios)*

Sunken Cargo Ship Explored

Captain Cousteau, who is also director of the Oceanographic Museum at Monaco, and his divers recently discovered a 2,200-year-old Greek cargo ship at 140 feet in the Mediterranean, near Marseilles, and recovered much of its ancient wine-jar cargo by thousands of aqualung dives. On a more recent mission, they surveyed 3,750 square miles of Mediterranean floor, to determine the practicality of a natural gas pipeline between Africa and Europe.

Oceanic Conservation Fleet

By Ross Leffler
Assistant Secretary of the Interior for Fish and Wildlife

We in the United States Fish and Wildlife Service are proud of our "fleet," probably not so much for what it is as for the job it is doing, for the history behind it and for the conservation history it is making.

There are among the ocean-going vessels operated by the Bureau of Commercial Fisheries some ships which are on the aging side. Only one is a new one built for the work it is doing; some are reconverted from surplus, and some were purchased because with a minimum of expense they could be adapted — at least "sort of" adapted — to the task ahead. One was even adapted to be a one-plane aircraft carrier as well as a boat of burden.

Total of 17 Vessels

There are seventeen vessels which we may consider "ocean-going," ranging in length from 57 feet to 179 feet. In addition, there are well over one hundred inboard and outboard craft varying in length from 16 to 40 feet, many of which are used in offshore work and might even be considered as "sea-going" craft. There are thirteen airplanes, not part of the fleet but helpful to it in many ways, and charter vessels which are usually hired for specific times and purposes. Then, too, some of our work is done by contractors who use their own ships in carrying out the job assigned.

Our fleet began—at least our pride in it began—with the construction of the *Fish Hawk,* which went into operation in 1880, eight years after the Federal fishery program got underway as a one-man organization. And the tradition which began with the *Fish Hawk,* to add consistently to our knowledge of life in the sea, will continue to be a cornerstone of the Service's policy.

First Pacific Services

The second vessel of the fleet, the *Albatross,* was constructed with funds authorized by Congress in 1881. The *Albatross* not only doubled in biological research and exploratory fishing in the Atlantic, from Halifax to the West Indies, but sailed through the Straits of Magellan to perform some twenty-eight years service in the Pacific Ocean.

Wartime Duty

During this period, 1888 to 1917, the *Albatross* did survey duty on the Hawaii cable route, was on patrol duty in the Bering Sea, and in Pribilof Islands fur seal investigations, spent a couple of years in the warm waters around the South Sea Islands and the Philippines, and even did some fishery investigations not far from Japan. The *Albatross* gained the reputation of being "the most famous ship of her kind afloat."

The extracurricular activities of these two famous vessels include a

DISCOVERER OF THE ROYAL RED SHRIMP. *A combination trawler-seiner, the* Oregon *is one of the principal exploratory vessels of the Bureau of Commercial Fisheries. While the* Oregon *generally operates in the Gulf of Mexico, it also located a number of new shrimp beds off the coast of the Guianas, South America. (U. S. Fish & Wildlife Service)*

hitch in the Navy, the *Fish Hawk* as a gunboat in the "mosquito fleet" in the Spanish-American War, and the *Albatross* as an auxiliary cruiser in the same hostilities.

For nearly half a century, forty-six years, the *Fish Hawk* rendered service to the nation. It was decommissioned in 1926. The life of the far-swinging *Albatross* was a bit shorter, being just under forty years old when, in 1921, it put into port for decommissioning. In 1929 the Navy tug *Patuxent* was turned over to the Bureau, and was renamed *Albatross II*. Later a North Atlantic trawler, now bearing the name *Albatross III*, was purchased for $1.00.

The "history-in-the-making" activities of our present fleet are not of the dashing and romantic type, but when the story of conservation of renewable resources is written, the deeds of the Bureau of Commercial Fisheries should have a prominent page.

Two Principal Tasks

The fleet has two main tasks, fishery biological research and exploratory fishing and gear investigations. It also has charge of transportation to and from the Pribilof Islands in the Bering Sea, and enforcement and supply responsibilities in Alaska. What effect statehood in Alaska will have upon the size and operation of the fleet we have been using in Alaska is a matter for speculation but we all know that the state will soon take over much of the responsibility which the Fish and Wildlife Service has been carrying for many years.

Here is a quick glimpse at our ocean-going fleet:

Exploratory Fishing and Gear Investigations: *Delaware*, a side trawler, 147 feet 10 inches long; home port, East Boston, Mass.; *Oregon*,

AMONG THE UNUSUAL WARDS *of the U. S. Fish & Wildlife Service are the fur seals of the Pribilof Islands, Bering Sea, Alaska. Ships of the Service make five round trips a year between Seattle and the Pribilofs, carrying supplies and other necessities, and occasionally personnel. (U. S. Fish & Wildlife Service)*

combination stern trawler and seiner, 100 feet long; home port, Pascagoula, Miss.; *George M. Bowers,* stern trawler, 70 feet long; home port, Pascagoula, Miss.; and *John N. Cobb,* stern trawler-seiner, 93 feet long; home port, Seattle, Wash.

Fishery Biological Investigations: *Hugh M. Smith,* tuna clipper, 128 feet long; home port, Honolulu; *Charles H. Gilbert,* special design 112 feet long; home port, Honolulu; *Black Douglas,* 152 feet long; home port, La Jolla, Calif.; and *Albatross III,* 179 feet long; home port, Woods Hoel, Mass., scheduled for decommissioning.

Vessels in Alaska Service: *John R. Manning,* 86 feet 6 inches long; *Teal,* 73 feet 2 inches long; *Pelican,* 73 feet 2 inches long; *Kittiwake II,* 72 feet long; *Auklet II,* 57 feet long; *Murre II,* 86 feet long; *Crane,* 84 feet 7 inches long; *Dennis Winn,* 148 feet long; *Penguin II,* 148 feet long.

Small Craft and Launches

Some of the larger and more important *small* craft include: *Blueback,* [*FWS*-1605], 38 feet long with a 10-foot 4-inch beam and 3-foot 6-inch draft; built in 1942, rebuilt in 1958; based at Boothbay Harbor, Maine, for use in sardine and other investigations. *Sablefish,* 40 feet long and based at Juneau for Alaska duty. *FWS* 1227, 35 feet long, based at Beaufort, North Carolina, for use in biological studies conducted from that station. *Alosa,* 48 feet long, based at Annapolis, Maryland, for Chesapeake Bay oyster investigations. *Phalarope II,* 40 feet long, East Greenwich, Rhode Island, clam investigations. *Shang Wheeler,* 50 feet long, Milford, Connecticut, oyster work. *Kingfish,* 43 feet long, St. Petersburg, Florida, for red tide investigations.

Unnamed launches—30 feet long, salmon investigations, Little Port Water, Alaska; 32 feet long, Gulf oyster investigations, Pensacola, Florida; 26 feet long, middle Atlantic investigations, [out of] Beaufort, North Carolina.

Underwater Television

The *George M. Bowers,* commissioned in 1956, is the newest of the big boats. Like most of the fleet it was built for some other purpose and converted for our needs from a Gulf shrimp trawler hull. The *Bowers* is primarily a gear research vessel which does a little exploratory work. It was based for three years in the clear waters of southern Florida and for the first time we were able to scrutinize the action of the various gear under water.

There are at least two things for which the *Bowers* will be remembered. One is the carriage which made underwater television a tool of our trade. The big problem was to get the underwater camera where it was wanted at the time it was wanted. Our research using the *Bowers* accomplished that. Another achievement of the *Bowers* staff and the University of Miami Marine Laboratory was the development of an accurate midwater trawl telemeter, a device that was bulky and hard to use, but it did tell the men on the deck just where the trawl was operating.

It remained for other Bureau per-

UNDERWATER TELEVISION *is a comparatively new aid to the fishing industry. It helps to determine just how well various fishing gear and nets are functioning, while out of sight of fishermen on deck. Here an enclosed camera, remotely controlled, is being lowered from the side of a research vessel into the water near Key West, Florida. The research vessel* George M. Bowers *pioneered in this useful work. (U. S. Fish & Wildlife Service)*

sonnel, working in our Seattle laboratory and on our *John N. Cobb,* to come up with a pint-sized telemeter, which can work on any ship which has the proper cable.

Tuna and Lobster Finds

The *Delaware* has contributed considerably to the knowledge of fishes of the western Atlantic. Among its achievements is the exploratory work done in the Gulf Stream. For hundreds of years, men of many nations have fished the Atlantic Ocean, but not until the *Delaware* did its exploratory longlining in the Gulf Stream was it known that there were tuna in large numbers in the western Atlantic. Likewise it was the *Delaware* that added to lobster knowledge by determining availability of the big ones in waters thought too deep for this delicacy.

The royal red shrimp of the Gulf of Mexico is an *Oregon* find. So is a

tuna fishery in the Gulf and also new shrimp fisheries of the coasts of Latin America and offshore from British, Dutch and French Guiana. On a recent trip to the Guianas, the *Oregon* discovered oysters 100 fathoms deep, which is much deeper than their hitherto accepted lower limits.

Shrimp In Northwest Waters

The *Cobb* proved that there are commercial quantities of shrimp off the shores of Washington and Oregon. That shrimp were present in those waters is something fishermen have known for a long while, but it took the *Cobb* explorations to prove the quantities, and to influence the processors to move in with their peelers to make harvest of the small shellfish a profitable venture. The *Cobb* also opened up a big shrimp resource in Alaskan waters, proved the extent of some shrimp grounds, and discovered entirely new ones.

To the *Hugh M. Smith* and the *Charles H. Gilbert*, the nation owes a debt it will not realize for some time to come. With these two vessels—and for some time the *John R. Manning*

LIVE TV FROM DAVEY JONES'S LOCKER. *This still photo, from an underwater television sequence taken at Key West, Florida, shows white grunt nosing around a shrimp trap at night. Underwater TV is expected to reveal many useful aspects of fish habits and behavior, as well as the functioning of nets, trawls and other gear. (U. S. Fish & Wildlife Service)*

NEW SHRIMP BEDS *were found in Alaskan waters by the* John N. Cobb, *based in Seattle. The* Cobb *proved also the commercial value of other grounds along the Oregon coast. A small but improved pint-sized telemeter (for determining depth) was developed on the* Cobb, *and at the Bureau's Seattle laboratory. (U. S. Fish & Wildlife Service)*

was with them—our scientists developed a potential food supply in the Pacific Ocean which will be valuable at a future date; they have uncovered some basic oceanographic data on upwelling and currents and counter currents in the Central Pacific, and established the relation of these to the food chain and to fish production. In addition, they collected wind, weather, air and water temperature data which is important in understanding the distribution of fish and the difficulties in harvesting certain fish.

Equatorial Countercurrent

The equatorial countercurrent in the Pacific, which races well below the surface, was one of the discoveries; the relationship of upwelling, by which nutrients from deep in the sea are brought to the surface, to the start of the food chain was shown; as was the presence of forage fish near the upwelling area and the presence of tuna near the forage fish. The conditions under which albacore live, the temperature limits and other attributes, have been recorded, and the

groundwork laid for sane exploitation when the time comes that this food supply is needed.

The *Albatross III* in spite of numerous handicaps attributable to age has made important contributions to the northwest Atlantic fisheries in its biological work, in conjunction with the Woods Hole Laboratory, on cod, haddock, and other bottom fishes. The *Black Douglas* operates out of La Jolla on oceanographic and biological studies.

Floating Seaplane Base

It was the *Murre II*, the 86-foot power scow, that was used as a plane carrier. The plane used was a cub-type with pontoons. Space was provided for it on the deck; a hoist was rigged to put the plane into the water and take it out of the water. This floating base made it possible for a small plane to reach areas which normally could be reached only at long intervals by the larger planes.

The chief responsibilities of the *Penguin II* and the *Dennis Winn* are in the transportation field. The *Penguin II* makes five round trips a year between Seattle and the Pribilof Islands carrying supplies and other necessities, and occasionally personnel. It is used in inter-island communication and brings fuel oil from Dutch Harbor 250 miles away. The *Dennis Winn* supports management and research operations in Alaska and does patrol duty at times. The *John R. Manning* is used for patrol duty where a ship of its size is needed.

The rest of the Alaska fleet is stationed at various points, mainly for patrol activities. Cook Inlet, Kodiak Island, Prince William Sound and numerous other places on the coast line of several thousand miles must be patrolled during the commercial fishing seasons.

This is the story of the Fish and Wildlife's fleet and yet it isn't all of the story—perhaps it should be about the men and not about the ships. There is much to be desired in the fleet itself, the need for a fleet built for a purpose, and with the best of everything incorporated in the construction. But that being impossible we have done the next best thing, we have manned these ships with faithful crews and put aboard some of the finest fishery scientists and technicians in the country. These men have obtained and will continue to gain results.

Eels Jam Turbines

The St. Lawrence Seaway is the last word in efficiency when it comes to moving ships from salt water to fresh, and vice versa. But the engineers forgot or overlooked migrating eels. They were discovered in the turbine equipment during maintenance operations at the Robert Sauders generating plant at Cornwall, Ontario. Several thousand eels were jammed in a space only a few feet deep and twenty feet long. Maintenance work had to be halted until the annual seaward migration was over.

WHALE IN THE GRASS *as seen from astern. Nothing is more helpless than a large sea creature washed into shallow water. This California gray whale was caught in a strong onshore wind and current along the Oregon coast, and finally deposited high on a grassy meadow. Shark bites about the throat and neck indicate that it may have been dead before it hit the beach. (Sloniker, Sea Lions Cave)*

Whale in the Grass

By RAYMOND M. GILMORE

DRY LAND, 300 yards from the ocean, is a most unusual place to find a whale, even a dead one. But this was the odd spectacle seen by people traveling Highway 101, along the coast of Oregon between Sea Lion Caves and Heceta Head, in April, 1958.

A severe storm, with strong onshore wind and a heavy onshore set to the waves and currents, brought the whale from the ocean to the land, transported it underneath a highway bridge, and deposited it high and dry on a grassy meadow. This was one of the few flat places along this stern and rockbound coast where such an event could have happened. The victim was a California gray whale on its northbound migration. Its habits had

placed it near land, where it was picked up by the surf and thrown ashore.

The whale was undoubtedly dead before it hit the beach. Large craters had been bitten from the throat and neck, which indicated attack by a large shark. But it must have had some previous misfortune since sharks do not attack live whales, unless injured. The scoops from the blubber were circular and a foot across, in a form typical of a shark's jaws.

At Sea Lion Caves, a few miles south of the stranding of the whale, thousands of people stop every summer to see the large colony of great northern sea-lions on the rocks below, and to explore the tremendous sea cave which runs beneath the cliff.

Nursing Whale

Tourists during the summer of 1958 had an extra reward from June to August. Seven to twelve California gray whales gathered and fed in the waters at the very foot of the cliff. When I visited the area on July 11, 1958, I saw seven gray whales there, and took color moving pictures.

Of the seven whales, one pair included a cow lying on her side, apparently nursing her calf, which looked to be about 20 feet long and undoubtedly was born the previous January or February, in a lagoon of Baja California. Another pair consisted of large adults, perhaps conjugal partners. The remaining three were in a trio: two were large whales, probably a big female and big male, and a third was smaller, probably a male.

Gray whales in migration can be seen each year at Sea Lion Caves, going north in late March, April and early May, and coming south in De-

CALIFORNIA GRAY WHALE, *broaching near the coast. Special excursion boats carry "whale watchers" out of San Diego for a closeup of one of nature's rarest spectacles, during the migration periods, December to mid-February (southbound) and March through April (northbound), when the big creatures obligingly swim fairly close to shore. Note the dappling or spotting of white, which, seen from a distance, gives the "gray" color. (Al Allanson)*

cember and January. But this was the first summer that the owners of the Caves had seen a small herd remaining in the adjacent waters. Nevertheless, it has long been suspected that a few gray whales stay throughout the summer along the coast of Oregon.

A small herd remained in waters off Crescent City and Pelican Bay in northern California in 1947 and 1948. I saw five near Crescent City on September 17, 1947; and, three days later, from aboard a whale-catcher, I observed nine at Pelican Bay. A fisherman reported twenty to me near shore at Crescent City on 21 September, 1947. The gray whales were feeding, not migrating, and were seen all summer by the whalers. I saw some again at nearby St. George Reef in June, 1948.

Travels 6,000 Miles

Ordinarily in summer the California gray whale goes all the way to the western Bering Sea off Siberia to feed. This is 6,000 miles from its breeding grounds in Baja, California. But with the population steadily increasing since 1938, when the whale received full international protection and whaling ceased, and, with a total estimated number of 5,000 for 1958, there may be more and more of these summer "vacationers" on the coast of northern California and Oregon.

In southern California the gray whale may be seen by the hundreds, even thousands, each winter from December through April as it migrates close to shore. This migration is becoming a very popular public attraction. Best spots are Marineland of the Pacific, at Palos Verdes, near Los Angeles; Laguna Beach cliffs; and Point La Jolla and Point Loma, at San Diego.

"Public Whale Watch"

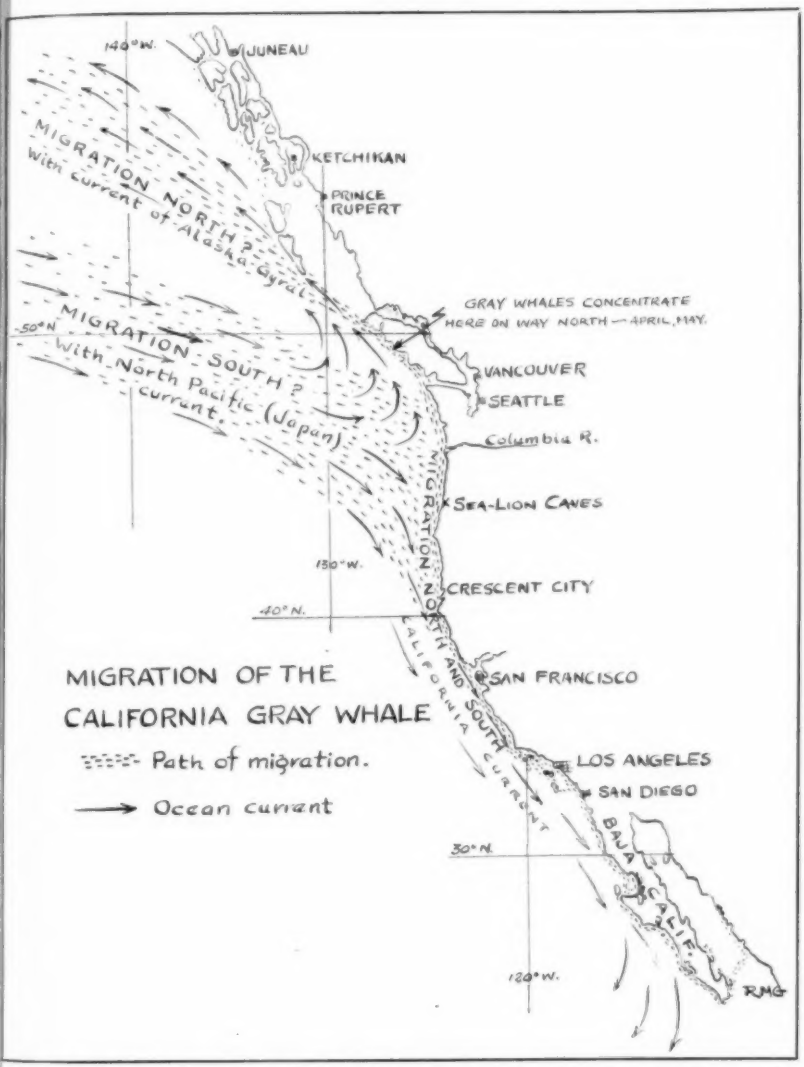
At Point Loma, from the Cabrillo National Monument, the U.S. National Park Service holds a "Public Whale Watch" every year to view the south migration, from the day after Christmas, to late February or early March. Ranger guides are on hand and binoculars are available. A half a dozen commercial boats also run excursions from San Diego, and nearby Mission Bay, to the migration path to bring landlubbers close to a whale—perhaps for the first and only time in their lives. The northward migration is more scattered.

With the public interest in the gray whale mounting, and the population of the latter increasing to the point where a limited harvest will be possible, the forces of conservation and those of exploitation could meet head-on.

The whaling industry, stimulated by the market for whale meat as food for pets and fur animals, is eyeing the gray whale again. Twice before in our history the gray whale has been harvested and decimated. If a third harvest is made, it is hoped that proper management will preserve enough to insure the pleasure of thousands of residents and tourists who come to the coast each winter to see the whale.

How to Spot Them

How can you identify a gray whale from all other whales? At the surface of the water, a gray whale shows a



WHALE TRACKINGS. *A map of the Pacific Ocean areas along the west coast of North America shows the relationship between the north and south migration patterns of the California gray whale and the prevailing ocean currents. Whale sightings. Some of them close to the shore, are common occurrences during the migration periods. (Map by the author)*

WORLD WAR II FIRE-CONTROL BUNKER, *atop Point Loma, near San Diego, now spots migrating whales instead of Japanese submarines. Here visitors may watch whale census-takers of the U. S. Fish and Wildlife Service at work, or visit a marine museum. The lookout is part of Cabrillo National Monument, one of the nation's tiniest Federal reservations, commemorating the discovery of California near here in 1542. (National Park Service)*

spotting or dappling of white on a dark background, which gives the "gray" color. Some of these white spots and blotches are discolored areas of skin; others are patches of white barnacles. The spout is single and fairly voluminous and is given three to five times between soundings. or long dives. The profile of the head and body are very distinctive. The top of the head is peaked at the nostrils from the slightly bowed condition of the head and upper jaw, and the bunching of the muscles for the blow and inhalation.

The back ends at a low fleshy ridge a foot long and several inches high. and this is followed on the upper ridge of the tail to the flukes, by a series of eight to ten small sharp knuckles, or bumps. The flukes themselves are thrown conspicuously out of water on the sounding dive and often show rounded tips, abraded by age and the vicissitudes of life, or sharply pointed in a wing-tip, but

always notched deeply in the center.

When close to an individual, either in the water, or more especially on the beach and dead, as was the Oregon whale in the grass, one can also see the short and broad flipper, the absence of the longitudinal deep grooves on the throat and chest as in the finner and humpback whales, or rorquals, and the two rows of white baleen plates in the upper mouth, through which the small food is strained en masse. The rows do not meet in front, as in other baleen whales. There are also two to three short, shallow, curved grooves on the throat, just behind the chin.

The specimen which washed ashore in Oregon was about 30 feet long, undoubtedly a yearling, going back north for the second time in its life. The first time had been as a suckling calf of 15 to 18 feet with its mother, a year previously. Adults grow to almost 50 feet.

Caves Man Aids Science

The photographs and details of the stranding were given to me by Mr. Sloniker, through Mr. Donald Houghton, of the Sea Lion Caves, Florence, Oregon. This is an excellent example of the help given to science by perceptive laymen with interest. Cetology, or the study of whales and porpoises, needs many of these contributors because the shores of the world are large and cetologists few.

Tagging the Yellowtail

Out in California, a yellowtail tagging project is turning up some interesting results. In the first place, returns have been good. Of 15,116 yellowtail tagged, according to the Dingell-Johnson Quarterly, recoveries have been 359. Movement of 50 miles or more were shown by 111 recoveries, 227 were retaken in the same area where originally released, but 21 returns were useless because of inadequate data.

Tagging returns continue to show that, of the yellowtail which get about, there is a northward migration during the spring and summer, and a southward migration in the fall. Sport fishing is dependent upon a limited number of fish which migrate from the south to the grounds available to California anglers.

At Los Coronadoes Island, 40 per cent of 53 yellowtail tagged and released have been recaptured, indicating that many fish caught and released by sport fishermen would be recaught again, perhaps several times. It is evident that sport fishing for yellowtail could be improved by a reduced take-home limit, and by stressing the sport of catching and releasing fish.

MAKING BAMBOO RAFTS *for oyster cultivation at Plover Cove, New Territories, Hong Kong. Since World War II, the demand for oysters and oyster sauce, mainly for export to the U. S. A., has been so heavy that it cannot be met by the production of the Deep Bay oyster beds. So artificial methods of "farming" oysters have been tried, with marked success. (Photo from authors)*

Fisheries Research in Hong Kong

By DAVID BARKER AND F. D. OMMANNEY
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University of Hong Kong

HONG KONG has increased in status and international importance very rapidly during the past two decades, yet for many its location still remains as vague as that of Timbuktu. As a matter of fact there is little difference in latitude, though much in longitude, between the two places, for Hong Kong lies just below the Tropic of Cancer at the mouth of the Pearl River, on the south-east coast of China. Across the estuary to the west is the tiny Portuguese colony of Macao; to the north stretches the vast hinterland of China and to the south spreads a sea slightly larger than the Caribbean, the South China Sea, whose shoreline includes territory belonging to Indo-China, Thailand, Malaya, Indonesia, Sarawak, British North Borneo, the Philippines, Formosa, and China.

Hong Kong was founded by the British in 1841. The colony consists

of a peninsula on the Chinese mainland (the New Territories) and a number of islands, in all a total of 391 square miles, inhabited by nearly three million. The primary product is marine fish, from a fishing fleet of over 8,500 junks and twenty Japanese-type trawlers.

Carp and mullet are cultured in ponds in the New Territories. Oysters are also grown, the meat being dried or processed into oyster sauce.

New Area For Research

Hong Kong provides ample opportunities for fisheries research. Situated almost at the junction of temperate and tropical waters, it is within easy reach of oceanic and estuarine fishing grounds. The fisheries scientist is faced with varied marine fauna and with a multitude of problems, not only in the sea but also in the oyster beds and fish-ponds. The majority of these have to be developed from scratch.

Thus, for example, the native oyster, which has been cultured in Deep Bay, New Territories, for centuries, was officially identified for the first time only last year, proving to be a species of *Crassostrea* (Bromhall, 1958). Systematic plankton and water sampling did not commence until 1954, and the first real study of the fishes in the area was not made until Professor R. L. Bolin, of Stanford University, visited the University of Hong Kong as a Senior Fulbright scholar in 1957-58.

THE MAP REVEALS *that much of the field work in fisheries research being carried out by the University of Hong Kong is not done on the small island of Hong Kong itself, but in the waters of the New Territories, along the mainland of China. Within this limited area a fleet of 8,500 junks and twenty Japanese-type trawlers constantly seek the products of the sea. (Map from authors)*

VISITING HIS NAMESAKE. *Sir Alister Hardy, M.A., D.Sc., F.R.S., and Linacre Professor of Zoology at Oxford University, takes some notes from the deck of the research vessel named in his honor. Sir Alister is one of the world's leading authorities in marine biology and fisheries research. (Photo from authors)*

War Interrupts All Work

Fisheries research in Hong Kong began in the early nineteen-thirties with papers, such as those by Henry Fowler on the fishes of China, published in the *Hong Kong Naturalist*. The impetus behind these studies came from Geoffrey Herklots, then Reader in Biology at the University of Hong Kong, and it was chiefly due to his efforts that fisheries research became an organized project in 1938.

Four years, 1938-41, saw the gradual emergence of a Hong Kong Fisheries Station within the University with Herklots as Director of a staff of eight Chinese. There was in fact no "Station" as such, but in 1941 funds for one were made available by the Hong Kong Government, plans were prepared, and the foundations had been laid at Aberdeen, main fishing port on Hong Kong Island, when the Japanese invasion forced the project to be abandoned.

Manuscripts Lost

Results of this period are described in two issues of the *Journal of the Hong Kong Fisheries Research Station* in 1940, and a book on the "Common Marine Food Fishes of Hong Kong" (Herklots and Lin, 1940); another book on the crabs, prawns, and shellfish of Hong Kong was in the press but the manuscripts and proofs were lost as a result of the war.

After the war, the Station reappeared as the Fisheries Research Division of the Government Department of Fisheries, but after a brief struggling existence, with a staff of two, this collapsed in 1949 on the resignation of its chief worker, S. Y. Lin, to join the staff of the Food and Agriculture Organization of the United Nations.

Money, But No Personnel!

The year 1949 was thus one of eclipse, and research ceased until three years later. Ironically enough the eclipse coincided with an offer of £135,000 by the British Government to finance the building and equipment of a research station at Aberdeen. Funds were available, but not the personnel and the scheme lay dor-

mant. Resuscitation came in the form of a joint attack on the problem by the Hong Kong Government and the University. The University, emerging from a period of rehabilitation into one of expansion, created a Chair of Zoology to which one of us (D.B.) was appointed, arriving in Hong Kong in 1951.

Steel Research Vessel

By this time it had been decided to reduce the British Government grant to £40,000, for a revised fisheries scheme. This provided, in effect, for a fisheries research laboratory and staff, attached to the University as a sub - department of Zoology, and a sea-going fisheries research vessel.

The Fisheries Research Unit, organized on these lines, commenced work in September, 1952, with two Chinese Assistant Research Officers and the Professor of Zoology as Acting Director. Today the scientific staff consists of two European Research Officers and six Chinese Assistant Research Officers: the post of Director has been held by one of us (F.D.O.) since September, 1957.

ONE OF THE BUSIEST SHIPS *in the Far East is the* Alister Hardy, *research vessel of the Fisheries Research Unit, attached to the University of Hong Kong. Prior to 1955 it operated on fifty-two stations within Hong Kong territorial waters; since then the pattern of sampling work has been extended farther afield. Locally-built, this sturdy steel ship is 60 feet long, draws less than 7 feet loaded, and displaces 51 gross tons. (Photo from authors)*

The research vessel, launched in November, 1953, is a locally-built steel vessel of 51 gross tons, 60 feet long, drawing 6 feet 6 inches when loaded. It was decided to name the vessel *Alister Hardy* in honor of Sir Alister Hardy, M.A., D.Sc., F.R.S., Linacre Professor of Zoology at Oxford University and one of the leading authorities in marine biology and fisheries research. For technical reasons it was impossible to operate the *Alister Hardy* in extra - territorial waters until May, 1955. Prior to this the vessel's activities were restricted to a hydrological and plankton survey at fifty-two stations in Hong Kong territorial waters. In December, 1955, the pattern of the sampling work was expanded, the number of stations in territorial water being reduced and others created further afield, in extra-territorial waters. This program is still in force.

The results of much of the Unit's work have been published in the *Hong Kong University Fisheries Journal,* which is a continuation of the *Journal of the Hong Kong Fisheries Research Station.*

Marine and Freshwater Work

The present program of research can be divided under two headings, marine and freshwater research.

The waters around Hong Kong are profoundly influenced by the fresh outflow of the Pearl River, to the west of the Colony. After heavy rains in China, during the months May to August, a pronounced drop in salinity of the surface waters occurs in the sea to the west and south of the estuary. This surface water is swept north-eastward by the offshore current of the south-west monsoon.

In these months there is a pronounced difference between the salinity at the surface and that at the bottom, a range which may cover 5-35‰. On the other hand the amount of dissolved oxygen at the bottom is less, owing to consumption by silt and organic matter, but is close to saturation at the surface owing to contact with the atmosphere.

Effect On Fish Population

These hydrological changes must have a marked effect on the plankton, the benthos, and thus on the fish population. The *Alister Hardy* has been carrying out a systematic hydrological and plankton survey designed to study these seasonal changes. Four radiating lines of stations have been worked since December, 1955, out to a distance of about 100 miles from Hong Kong towards the edge of the Continental Shelf. Each line consists of six stations, at which Nansen reversing bottles are used for water-sampling and temperatures, and a surface 50 cm. *Discovery* type plankton net is towed.

With the assistance of commercial vessels further water samples are taken regularly between Hong Kong and Macao, Hong Kong and North Borneo, and Hong Kong and Formosa. In addition to analyses for chlorinity and oxygen content, the hydrologists are taking observations on phosphate and nitrate content by means of a Spekker double-cell absorptiometer. It is possible to distinguish several distinct

types of plankton fauna. Maximum growth occurs in January and in August.

Two distinct types of fish population may be distinguished in the waters around Hong Kong. First, the inshore waters are invaded in great quantities by migratory fishes, which appear seasonally and from the basis of a number of seasonal fisheries.

Changes In Fish Groups

Schools of mackerel and crevalle (Carangids) appear in the summer months. In the spring and autumn anchovies appear, but the spring species of these are different from the autumn ones.

In the winter months the yellow croaker is found in great numbers, mainly in the estuarine waters to the west of the Colony. It forms the basis of an important winter fishery. Other croakers (Sciaendae) appear in the spring and autumn. Besides these there are the mackerel scad and the white herring, which enter the inshore waters in the winter and spring months.

Secondly, there are the inshore bottom fishes, of which the golden thread is by far the most important. These fishes are most abundant in the winter months.

Sticky Grey Mud Bottom

Further out, at distances varying from 60 to 250 miles, lie the trawling and long-lining grounds, which extend to the Continental edge. This at its nearest point lies 100 miles S.E. of Hong Kong. The grounds worked by mechanized pair - trawlers and long - liners, based on the Colony,

ONE OF THE AUTHORS, *Dr. F. D. Ommanney, lowers a vertical-closing plankton net from the side of the* R.V. Alister Hardy. *Because the waters around Hong Kong are profoundly influenced by periodic fresh outflows of China's mighty Pearl River, a systematic survey of plankton content was undertaken to determine seasonal changes, and their effects on the fish population. (Photo from authors)*

cover the Continental Shelf mainly in a south-westerly direction as far as Hainan Island and the Gulf of Tonking 200-300 miles away.

Over the whole of the area is a gently sloping bottom of sticky grey mud, at depths between 30 and 100 fathoms. This area is populated by a wide variety of fishes, of which the most important are the Red Sea bream, the lizard-fish, the ginkgo fish, the red snapper, the conger pike, and many others. The best fishing season

INSPECTING CULTURED *oysters growing from rafts in Tolo Harbor, on the east coast of the New Territories. Not only native oysters, but imported Japanese oysters and European oyster spat have been successfully grown here since 1956. (Photo from authors)*

on these grounds is from September to January with a minimum in July and August.

As for migratory fishes, the activities of the Unit have so far been limited to a study of the seasonal variations in abundance, and the spawning and feeding habits of individual species. One member of the staff is completing such a study of the yellow croaker, covering several years based mainly on market samples. Another is carrying out analyses of the golden sardine and on anchovies.

Future Lies in Trawling

Further research in Hong Kong, however, must undoubtedly be directed towards the trawling grounds to the south-west. To date the program of the Unit has had two principal objectives: the mapping of the distribution of the ground fishes and seasonal variations, and second, statical studies to determine the proportions of mature and immature fishes in the catch, together with the size and weight of the various species at sexual maturity. From this data, gathered over a number of years, an estimate of the effects of fishing on the stock may be obtained. Other surveys, designed to study catch per unit of effort, must await a larger vessel which can tow full-sized commercial trawls.

Work on the natural history of individual species of ground fishes has also been undertaken. An account of the fishery for the golden thread group, the most important inshore ground fish, has already been published. Research on age determination has been carried out on the Red or Wave Sea bream, which is one of the staple offshore ground fishes. In general, in tropical fishes it is usually difficult to detect any sign of growth markings on the scales.

Edible Prawns for U.S.A.

Further marine investigations are in progress on the natural history of the commercial species of edible prawns. The export, mainly to America, of edible prawns, belonging to the family Penaeidae, is an industry which has grown up since the war. The *Alister Hardy* has been engaged during the past year on a beam-trawl survey of the inshore waters around the Colony, supplemented by studies from market

samples. Twenty - two species of prawns have been identified among the commercial Penaeids of these waters.

The line of investigation which has yielded the most clear-cut results has been the experimental cultivation of edible oysters. The local method of culturing the edible oyster is inefficient, for it consists in merely scattering rocks and stones on the sea-bed on which the spat settle. The mature oysters are gathered by divers or by the use of tongs.

Another industry since the war is the production of dried oysters and of oyster sauce, mainly for export to the U.S.A., creating a demand for oysters in bulk. This cannot be satisfied by the production of the Deep Bay oyster beds, even though in 1957-8 a record figure of 1,494 tons of shucked oysters were produced.

"Hanging Drop" Method

Experiments have been conducted by the Fisheries Research Unit, in cooperation with the Government Fisheries Division, on the growth of oysters by the "hanging drop" method. Here oysters are grown hanging from latticework bamboo rafts on wire or nylon "strings" or "drops." In the Deep Bay experiments, oysters spawned in 1955 were transferred to a bamboo raft anchored in shallow water in Deep Bay. The shells, with their attached oysters of approximately five months of age, were spaced close together in strings or "drops" of three. As the oysters grew they formed clusters of from twenty to ninety individuals at the beginning of the experiment, and progressively less on average as oysters died from various causes.

FARMING OYSTERS *at Tolo Harbor, Hong Kong. A Chinese assistant holds a "string" or "drop" of oysters which he has pulled from the water. Young oysters or spawn are transferred to strings of wire and nylon, and suspended from bamboo rafts until they mature, in about a year. (Photo from authors)*

The growth rate was followed by measuring the shell diameters and the dry meat weight at monthly intervals. Bromhall found that the oysters matured at one year of age, grew continuously throughout their first winter, but "stagnated" during their second. Bromhall concluded that the native oyster of Hong Kong was well suited

to the conditions in Deep Bay and could be successfully cultivated by the "hanging drop" method.

Pollution Threatens

A long arm of the sea, named Tolo Harbour, on the east coast of the New Territories, having shallow sheltered water, was chosen for cultivation experiments. Here not only native oysters from Deep Bay but imported Japanese oysters *(Crassostrea sp.)* and European oyster spat have been successfully grown since 1956. In March 1957, 200,000 spat from Japan were hung on wire and nylon from four rafts and later from six rafts. Growth has been very rapid, in fact more rapid than in Japan or in Canada, America, and Australia, where the Japanese oyster has been successfully introduced.

Tolo Harbour is an area where rapid industrialization is taking place. Factories are being built with outfalls into shallow landlocked bays. Large areas of shallow water and tidal swamp are being reclaimed for development. This is also happening in other parts of the coast of the New Territories, especially on the southwest side. Many inshore shallow-water harvests, such as crabs, cockles, prawns, etc., humble yet important in the provision of protein for the diet of the Colony, will be seriously affected. An investigation into the effects of industrial pollution upon sea water, with special reference to the basic oxygen demand, is being undertaken by one of the hydrologists on the Unit's staff.

(This is the first of two articles on fisheries in and around Hong Kong waters by Drs. Barker and Ommanney. Part II, "South China Seas," will appear in a future issue of *Sea Frontiers*—Editor.)

Bingham Oceanographic Laboratory

New and greatly enlarged facilities for the Bingham Oceanographic Laboratory are now in operation at Yale University. Generous bequests and donations supplied the necessary funds for the construction of a three-story wing to Peabody Museum, the addition being dedicated October 30, 1959.

Established in 1930, when the late Harry Payne Bingham, of Yale, gave his outstanding marine collection to the University, the Laboratory since 1940 had occupied a 19th Century mansion which was totally inadequate to house the work of modern oceanography.

Principal donors who made the building possible, in addition to Mr. Bingham, were the late Wendell A. Anderson, who had sponsored a number of oceanographic expeditions from Yale in the past decade; Allen Shelden III, William Warren Shelden, and Thomas H. Shevlin.

A more detailed illustrated account of this laboratory will appear in a subsequent issue of *Sea Frontiers*.

New Fishes for Hawaii

By JOHN E. RANDALL

HAWAIIAN FISH FAUNA is unique in its lack of shallow-water groupers and snappers. These fishes are found throughout tropic seas, and their absence from Hawaii presents an enigma.

There would seem to be no good reason for this odd situation. Although the Hawaiian Islands border the subtropical zone and the sea temperature is cooler than in most tropical regions, fourteen species of snappers of the genus *Lutjanus* and fifteen groupers of the genus *Epinephelus* are found in the even cooler waters of southern Japan. Groupers and snappers feed primarily on small fishes and crustaceans; these abound in Hawaii, so the food supply would not seem to be the limiting factor.

Isolation of Hawaii

The most likely explanation for their absence is the great isolation of these islands from other island groups in the tropical Pacific, both in terms of vast distance and the direction of ocean currents. No current flows from the closest land, such as the Marshalls, Wake, and the Line Islands, to the Hawaiian group. Groupers and snappers are reef fishes, and it is not likely that they swim as adults across stretches of open water; in all probability their distribution results from passive transport of larvae by ocean currents.

Other reef fishes have successfully colonized Hawaiian waters, so we must look for something different in the grouper and snapper families during their planktonic existence. The most logical would be a short larval life. Before the little fish might reach the northwestern end of the Hawaiian chain in the long route from the Ryukyus and southern Japan in the Kuroshio and North Pacific currents, their larval life would end and they would perish for want of shoal areas with abundant food and rocky shelter.

THE AUTHOR TAGS *a tarao, or small spotted grouper, in order to obtain information about its growth and migrations. One thousand of these groupers were tagged with plastic disks and released in Moorea, Society Islands. Forty-four of those tagged have been recovered. (D. Carroll)*

HAPPY TRANSPLANT. *This underwater photograph, taken at a depth of 80 feet off Brown's Camp, Oahu, shows a transplant apparently settled in its new home. The upper fish, a grouper* (Epinephelus fasciatus) *was introduced in 1958 from the Marquesas Islands, where it is known as the taiau. (Division of Fish and Game, Hawaii)*

On the other hand, there appeared to be no reason why certain groupers and snappers should not be introduced by man to Hawaii. Wherever these fishes occur naturally, they are of considerable importance as food.

Food and Sports Values

They have great value as sportfish, both for anglers and spearfishermen. In Hawaii a large percentage of the population participates in sportfishing from shore or in small boats. Without groupers and snappers, the usual inshore catch of small wrasses, goatfishes, squirrelfishes, mullet, and occasional jacks is usually not too exciting.

Mr. Vernon E. Brock, then director of the Division of Fish and Game of the Territory of Hawaii, decided to investigate the possibility of introducing certain fishes to Hawaiian waters. But before bringing fishes in, it was felt that something should be learned about their biology.

Biological Mistakes

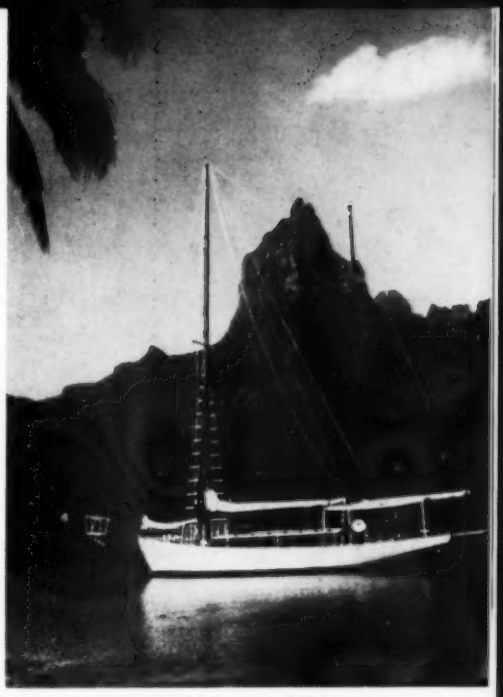
The history of man's intentional introduction of animals and plants from native regions to new areas is full of examples which proved more injurious than advantageous. The raucous mynah bird was brought into Hawaii for insect control, but has been a major factor in the extinction of some native birds. The mongoose was introduced to reduce the population of rats. However, the rat is primarily nocturnal and the mongoose diurnal. Instead of controlling the rat, Hawaii merely added another pest. It would not take much biological study to avoid such mistakes.

There have been fifteen different attempted introductions of animals to the marine realm in Hawaii, mostly without success. Transplantations from California of abalones, cockles, pismo clams, California oysters, anchovies, striped bass, and chinook salmon failed to become established. The probable reason is that the water is decidedly warmer in Hawaii than off California. Much effort and expense could have been saved had some simple research been carried out on the temperature tolerance of these organisms.

A few introductions to Hawaii, such as the Japanese clam (*Venerupis philippinarum*) and the Samoan crab (*Scylla serrata*), have been eminently successful, although there have been complaints because of injuries to persons from the powerful claws of the latter.

Of all the introductions of aquatic organisms to Hawaii, only one—or at most two—have been made by an official agency of the territorial government. Little, if any, preliminary research on the organism under consideration for introduction was ever carried out. It is true that there would seem to be less risk of an introduced animal being disadvantageous in water than on land. Nevertheless there is risk. An introduced grouper which feeds heavily on young spiny lobsters would certainly not be wanted. It would not be as valuable as the lobster population it would deplete.

A fish which is prone to be poisonous, such as certain large snappers and groupers, especially should be avoided. A slow-growing fish would not be an asset. Although it might not be harmful, it would be a bad choice from the standpoint of productivity.



RIDING AT ANCHOR *in beautiful Papetoai Bay, Moorea, the author's vessel, a 37-foot ketch, served both as home and laboratory. The author spent a year in the Society Islands, studying the biology of groupers and snappers being considered for introduction into Hawaiian waters. (John E. Randall)*

Blessed or Cursed

The communities of plants and animals in tropical seas are extremely complex and little understood; consequently changes that may occur as a result of the introduction of a new organism are very difficult to predict. One thought should guide anyone transporting an animal or plant from one part of the world to another: the new locality will probably have to live with the organism, if it becomes established, for all time. This is especially true in a marine environment, where the eradication of an undesirable form would be extremely difficult or impossible. If the introduction is of value and does not reduce some other valuable form of life or cause any other bad effect, the responsible person may be universally blessed. But if the choice is a poor one, he may be eternally cursed.

After a discussion with Mr. Brock on the subject of the introduction of groupers and snappers to Hawaii, the author secured a research fellowship from Yale University and the Bernice P. Bishop Museum in Honolulu to go to the Society Islands and study the biology of groupers and snappers. Financial assistance was also provided by the territorial Division of Fish and Game, with Federal funds made available by the Dingell-Johnson act.

The Society Islands lie about 2,300 miles south and slightly east of Hawaii. Like the Hawaiian group they are high islands. They are nearly as far south as Hawaii is north, and the monthly sea surface temperatures approximate those of Hawaii (although, of course, six months out of phase). They were within range of the author's vessel, a small ketch which served as a mobile home and laboratory. And, more important, they were to be visited by oceanographic vessels of the Pacific Oceanic Fishery Investigations of the United States Fish and Wildlife Service, operating out of Honolulu, thus providing opportunity for shipment of living fish to Hawaii.

A Grouper Named "Tarao"

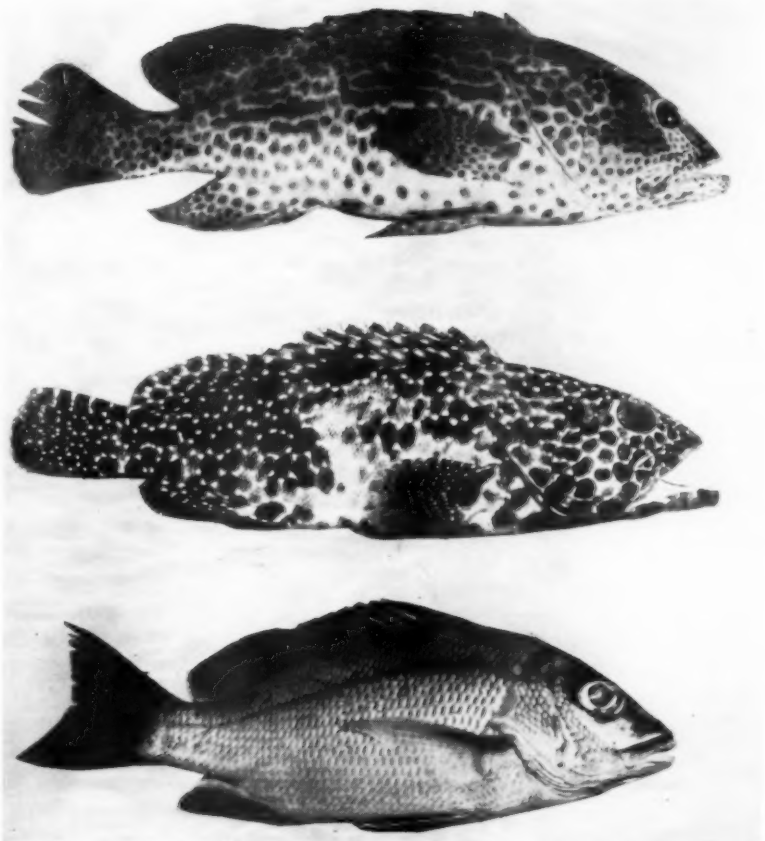
After a month's work in Tahiti, which is more populous than the other Society Islands and more heavily fished, it was decided to move to Moorea, twelve miles west, where groupers and other inshore food fishes are a little more abundant. A year was spent at this island, primarily in studying a small spotted grouper known by the native name "tarao." This species is the dominant carnivorous fish in the coral areas of lagoons. The stomach contents of a total of 465 tarao, obtained mostly by spearing, were examined. About two-thirds of the food material was crustacean—mostly crabs and shrimp—and nearly all of the remaining third was fish. These percentages were not the same throughout the year; during the southern summer when the young of many fishes were abundant on the reefs, the amount of fish in the diet of the grouper went up sharply.

One thousand tarao were tagged with Petersen disk tags of different colors. The word "Reward" was printed on each tag in three languages: French, English, and Tahitian, with instructions as to where to bring the tagged fish written in French.

Forty-Five Recoveries

Forty-five tagged fish were recaptured up to two years after release, providing data on growth and movements. Except for those fish which were transported from the original place of capture before release, none displayed any significant movement, and it was concluded that the species normally does not migrate. Over the period of eight days 1,067 tarao were examined in the Papeete market. Each was measured and sexed, and the resulting length-frequency graph revealed that males were considerably larger than females.

The male fish averaged about 200 mm in length to the base of the tail; the largest was 254 mm (about 12



THREE FISH IMMIGRANTS *to Hawaii, brought from Tahiti in 1956. The upper fish is the tarao* (Epinephelus merra), *a grouper; the middle one the tarao au* (Epinephelus hexagonatus); *and the lower one the toau* (Lutjanus vaigiensis), *a snapper. All are relatively small species, rarely exceeding a foot in length. (John E. Randall)*

inches in total length). The females averaged about 160 mm, the largest being 209 mm.

Pair Up at Nightfall

Ripe female fish were found from January to April. Spawning occurred each month over a period of three to four days, the peak two to three days before full moon. The actual spawning was not observed; however the groupers, normally not gregarious, were observed to pair up as nightfall approached during this period. On several occasions the eggs of the tarao were artifically fertilized and the early development up to five days

ONE OF THE SHOWIEST *of the reef fishes of Tahiti is the roi* (Cephalopholis argus), *a dark grouper with brilliant blue spots. Here it is about to be released off Oahu, Hawaiian Islands. In its native waters the roi attains a size of 18 inches, and is an important food fish of the Society Islands. (Division of Fish and Game, Hawaii)*

studied. The author's wife, also a biologist, conducted a major part of this research.

The food habits and habitats of fourteen other groupers and snappers were investigated. A detailed account of these data has been submitted for publication to the *Transactions of the American Fisheries Society*.

Making the Selection

In August, 1956, Mr. Brock and an assistant came to Moorea to decide on which species to introduce to Hawaii and to make preparations for the shipment. Three groupers, the tarao (*Epinephelus merra*), tarao au (*Epinephelus hexagonatus*), and the roi (*Cephalopholis argus*), and the snapper called toau (*Lutjanus vaigiensis*) were deemed desirable.

These species are the primary market fishes of the respective families in Tahiti and appear to withstand considerable fishing pressure. All are relatively small as groupers and snappers go.

What About Poisonous Fish?

The larger groupers such as the tonu *(Plectropomus leopardus)* and snappers like the taivaiva *(Lutjanus monostigmus)* frequently cause ciguatera (tropical fish poisoning). The toxicity of these fishes is not inherent in the flesh of the fish but results from something in their diet.

Although there has not been any serious ciguatera problem in the principal Hawaiian Islands, one can not say that an outbreak will never occur. Such an outbreak took place in the Line Islands (Palmyra, Fanning, Christmas) in the early 1940's. Ciguatera was unknown in these islands for at least 100 years. Therefore the species of fish which are the worst offenders in this respect should not be considered as prospects for introduction—at least until we learn the cause of ciguatera and a means to prevent it.

Still another line of reasoning militates against the introduction of the larger groupers and snappers of Tahiti to Hawaii. Frequently they were found with fishes of commercial importance in their stomachs. The smaller species contained more crustaceans, and what fishes they ate were nearly all of little or no value as food to man. The sportsman might prefer the larger species as game fishes and it cannot be denied that the larger

fillets therefrom are appealing. But if one considers the enormous loss of protein, in the form of smaller but utilizable fishes that such groupers and snappers consume to attain their alluring size, then it would seem wise to exclude them. Such a decision is made easily if one is a Neo-Malthusist.

Circular Pens Built

In order to accumulate live fish and hold them until the arrival of the Fish and Wildlife vessel, two circular pens about fifty yards in diameter were built by Tahitians in the Moorea lagoon off the village of Faatoai in water about four feet deep. The sides of the pen were constructed of one-inch mesh chicken-wire, tied to stakes of ironwood at about one yard intervals. About one foot of the bottom edge of the screen was turned inward and a low wall of coral rock built on it.

After the enclosures were complete, local fishermen were asked to supply live fish, and in particular the smaller individuals of the various species. The Tahitians on Moorea fish with hook and line from outrigger canoes, usually without sail or outboard motor, with small fish (commonly omah, the young of the goatfish *Mulloidichthys samoensis)* or pieces of octopus as bait. Bait fish are kept alive in spindle-shaped bamboo live cars called haapes, and the fish which are caught are transported back to the village in larger haapes which are towed astern from the canoes.

Fed Twice Daily

The fishermen were paid nine Pacific francs (about 16¢ U. S. money) for each grouper and snapper they supplied. Very large fishes and those in bad condition due to long retention, crowding in haapes, or injury from the hook were not accepted. The fishes were fed twice daily in the pens.

On September 16, 1956, the *Hugh M. Smith* anchored off Faatoai and nearly 2,000 groupers and snappers were loaded into the large live well on the vessel for transport to Hawaii. Aboard the vessel they were fed frozen smelt. Only 315 died en route, more than half of which were toau. Immediately upon arrival in Honolulu, the fishes were treated for a period of five days in the live well with copper sulfate solution to rid them of external parasites. The solution was dripped into the well at a constant rate to maintain a copper ion concentration of 0.4 to 0.8 parts per million. At this level the copper ion is lethal to protozoans and other invertebrates but not to fish.

Final "Planting" in Hawaii

The fishes finally were planted in Hawaiian waters by the Fish and Game research vessel *Makua* from October 10 to October 17. All of the fish of one species were released in one or two small sectors in order to ensure maximum reproductive capacity. The areas chosen were those that most conformed to the habitats occupied by these fishes in the Society Islands. A total of 469 tarao and 239 toau were released at Coconut Island in Kaneohe Bay, Oahu, an area which approximates the lagoon conditions normally occupied by these fishes. (The Hawaiian Islands lack typical

lagoons, cut off from the open sea by barrier reefs, such as are found in the Society Islands.)

Another 132 tarao were released off Wainini on the island of Kauai. The tarao au and the roi, although found in lagoons and bays, are most abundant outside barrier reefs. 113 tarao au were planted at Keoneoio, Maui, 171 roi off Brown's Camp, Oahu, and 400 roi off Keahole Point on the Kona coast of Hawaii.

No Fishing—Yet!

These plantings are intended as "seed stocks" and not to be fished directly, as one might hatchery trout in a stream. In order to educate the fishing public in Hawaii that these stocks should not be disturbed, articles appeared in newspapers and a TV program, utilizing motion picture films of the Moorea operation, was presented. A display of the introduced species was maintained in the Honolulu Aquarium at Waikiki. In addition, steps have been taken to obtain legal protection of the fishes.

The Tahitian names of these fishes will be adopted as the official Hawaiian names. It is only fitting that they should be. There is already a considerable similarity between the names of fishes common to both the Society and Hawaiian Islands, a reflection of the colonization of the Hawaiian chain by Polynesians who set forth, centuries ago, in huge double-hulled sailing canoes from Raiatea, then the cultural center of the Society group.

The first phase of the introduction, the establishment of adults, has been successful. In a letter written two years since the fish were planted, the new director of the Division of Fish and Game, Michio Takata, states, "The roi introduced from Moorea in 1956 are being sighted near the site of release [Brown's Camp]. These have grown from an average length of about eight inches when introduced to about sixteen inches."

Other groupers have also been sighted (and a few caught by fishermen) near the places of release. Three toau have been taken by fishermen, one in Waimea Bay, one off Kahala, and the other off Honolulu Harbor—all localities at considerable distance from Kaneohe Bay.

In June of 1957, a fisherman who had assisted in planting tarao on Kauai, reported that he had seen young about three inches long. Brock and Takata went to the area to investigate but found none.

Still Some Question Marks

There is as yet no definite evidence that the final phases of introduction, namely the spawning by adults and survival of young, have taken place for any of the new fishes. It is possible that normal spawning has been delayed or impeded because of the transferring of fish from the Southern Hemisphere to the Northern, where seasonal temperatures are out of phase.

Or spawning may have occurred and some factor or factors have prevented the development of the young in the plankton. It is also possible that normal spawning and development have taken place and the young have

not yet been observed. One year of ardent search for juvenile tarao in Moorea resulted in the collection of only three specimens. If the tarao have spawned in Hawaii the young could not be expected to occur in nearly the abundance that they must in an area like Moorea where this grouper is firmly established.

Shrimp Also Desired

While in the Society Islands the author was introduced to an epicurean delight—a fresh-water shrimp of the genus *Macrobrachium*. This shrimp occurs throughout the tropics but not the Hawaiian Islands. The suggestion was made to Mr. Brock that it be considered for introduction to streams in Hawaii. He went to Guam with Takata in November, 1956, and brought back 340 shrimps. Ultimately about 100 were released in Pelekunu Stream on the windward side of Molokai. Nearly a year later the stream was checked for shrimp, but none were found.

The Nato Story

Since the author has left the Pacific, activity in introduction of aquatic organisms to Hawaii has continued most energetically. Two aquatic biologists from the Division of Fish and Game, T. Fujimura and S. Shima, went to Tahiti in spring, 1958, to investigate the possibility of introducing the nato (*Kuhlia* sp.), a fish of marine origin which is plentiful in streams in the Society Islands, to Hawaii.

The French Government requested that nato be transported to the Marquesas Islands in return for the privilege of taking them in Tahiti. A total of 1,868 nato was collected from a stream in the district of Tautira and loaded in the salt water bait tank on the *Hugh M. Smith*. Only 94 survived the trip to Nuku Hiva. Fifty were planted in Taipi Vai (the Typee of Melville), and 44 retained for shipment to Hawaii; however the latter group all died in two days. Prior to this unsuccessful attempt to introduce large numbers of nato from the Mar-

EXCEPTIONALLY GOOD TO EAT *is the large shrimp,* Macrobrachium lar, *from the fresh waters of Guam, which the Division of Fish and Game is trying to establish in Hawaiian streams. This shrimp may reach an even larger size than the one shown. Of seventy-two fresh-water shrimps brought from the Marquesas to Hawaii, forty-two survived the ten-day voyage and were placed in a hatchery pond at Nuuanu, Oahu. (Division of Fish and Game, Hawaii)*

MODERN NOAH'S ARK. *Ordinarily the* Hugh M. Smith, *research vessel of the Pacific Oceanic Fishery Investigations of the U. S. Fish & Wildlife Service in Honolulu, is engaged in oceanographic work and exploratory fishing for tuna. But its live wells and tanks served to transport groupers, snappers and sardines from the Society Islands and the Marquesas for release in Hawaiian waters. (U. S. Fish and Wildlife Service)*

quesas, a few *Kuhlia rupestris* were transported by air from Guam to Hawaii.

While the *Hugh M. Smith* remained in the Marquesas, snappers and groupers of eight different species (only the toau being the same as those discussed previously) were obtained from native fishermen and placed in the live well. Ultimately, 2,435 snappers *(Lutjanus kasmira),* known as kokape in the Marquesas, were released in Kaneohe Bay, Oahu, along with small numbers of three other snappers (40 *Lutjanus gibbus,* 23 *Lutjanus vaigiensis* and 12 *Lethrinus* sp.). Fifty-one taiau *(Epinephelus fasciatus)* were planted at Brown's Camp, Oahu, in addition to 22 *Epinephelus spiniger* and 8 *Cephalopholis urodelus.*

Takata has reported that kokape found their way all around Oahu. Only two weeks after being planted, a trap fisherman caught a few off Barber's Point on the other side of the island from Kaneohe Bay. Unlike the snappers, the groupers from both the Societies and Marquesas have apparently not wandered far from their point of release in Hawaiian waters. They can be observed more or less at will, and underwater photographs have been taken of them.

Seventy-two fresh-water shrimps *(Macrobrachium)* were also loaded on the *Hugh M. Smith* when in the Marquesas. Forty-two of these survived the ten-day trip to Honolulu and were placed in a hatchery pond at Nuuanu, Oahu.

Still another important introduc-

tion for Hawaii was attempted from the Marquesas: the Marquesan sardine, *Harengula vittata*. Hawaii is in dire need of a good bait fish resource for tuna, and this sardine would be invaluable. Four transplantations of from 20 to 90 buckets of these fish were made via the *Hugh M. Smith* and *Charles H. Gilbert* from December 17, 1955 to December 14, 1957. Judging from the small size of Marquesas sardines taken from July to October, 1958, and their occurrence at islands where not originally planted, this species has probably spawned in Hawaii and is established. (Murphy, in press, *Pacific Science*).

Tilapia from East Africa

Tilapia mossambica, a plant-feeding fish native to estuarine waters of east Africa and capable of living in both fresh and sea water, was successfully introduced to Hawaii in 1951. This species has been used as a tuna bait fish and is of importance as food in its own right. In addition, it is said to be of value in keeping irrigation ditches from being clogged with algae.

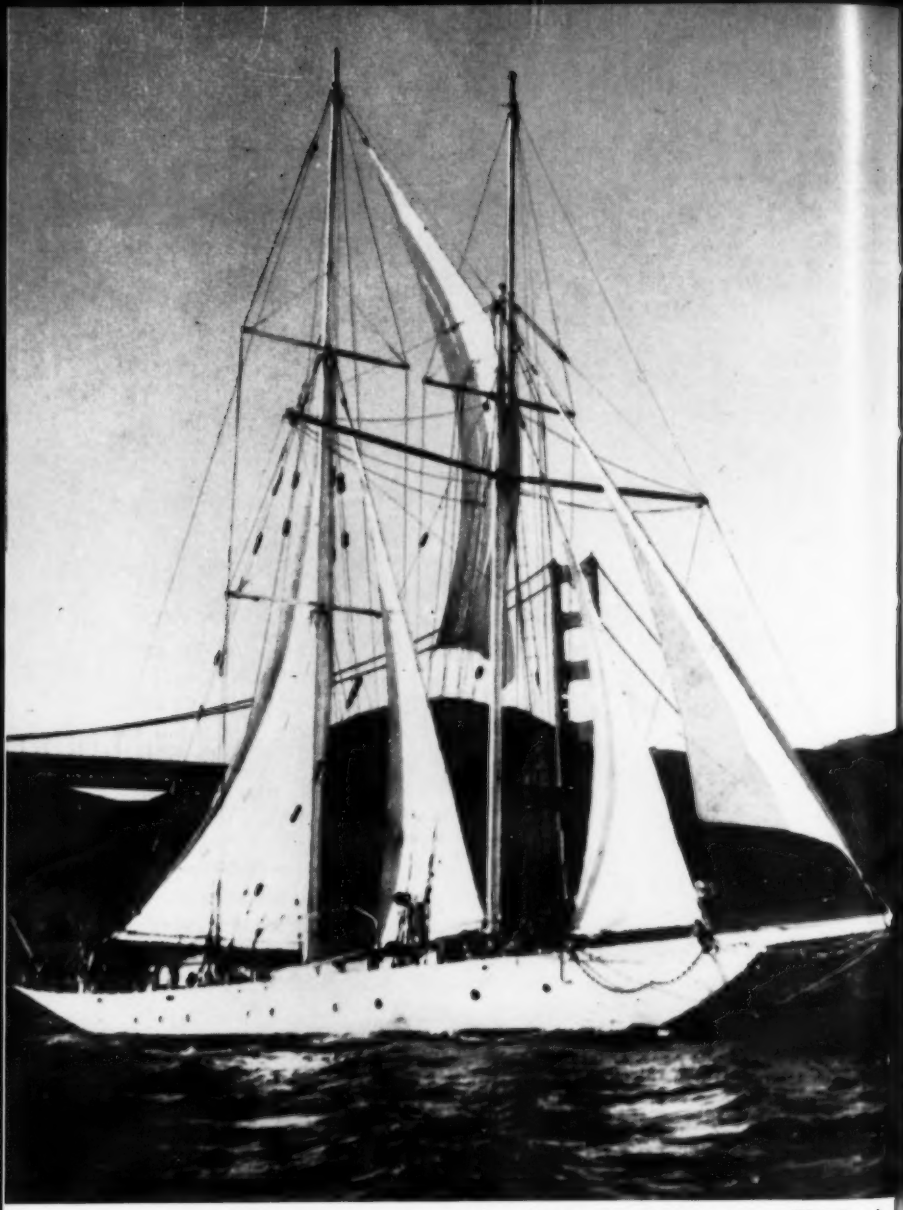
More recently three other species of the edible tilapia have been introduced, *Tilapia zilli* from Antigua, British West Indies, and *T. melanopleura* and *T. macrochir* from the Belgian Congo. *T. melanopleura* and *T. zilli* are notable for feeding on coarse aquatic vegetation. Both species eat the root, bulb, and leaf of the water hyacinth, a notorious pest, leaving only the hard core. An experiment is in progress on Maui to determine the effectiveness of these species in controlling water hyacinths in reservoirs.

Other Fresh Water Introductions

It should be mentioned that the fresh waters of Hawaii already have received a great deal of attention with respect to the planting of fishes from other parts of the world. The large mouth black bass and the bluegill sunfish have been established in reservoirs and ponds throughout the islands. Numerous efforts have been made to introduce rainbow trout to various streams, but only in a cool stream at Kokee on Kauai were the plantings successful. Brown trout or brook trout have not survived permanently in any Hawaiian locality. A cichlid fish, the peacock-eye, (*Astronotus ocellatus*) was introduced to the Nuuanu Reservoir in 1952 from stock provided by the Steinhart Aquarium, San Francisco.

Host of Aquarium Fishes

A host of tropical aquarium fishes, such as the guppy, dojo, barb, topminnow, moonfish, firemouth, swordtail, and mollies, have found their way into Hawaiian fresh waters, probably as a result of home aquarists who tired of their hobby and dumped their fish in the nearest pond or stream. Mr. Brock has written that these fishes are not edible, but they consume a good portion of the available food for fishes which can be eaten by man. He added, "Whether this is a wholly bad thing or not may turn on whether the public prefers ornamental or food fishes in public waters."



ARGOSY OF THE STUDENT SCIENTISTS, *the schooner* COLLEGIATE REBEL. *This handsome craft has a steel hull and mainmast, auxiliary diesel power, and accommodations for eighteen persons. The forward compartment has been converted into a well-equipped biological laboratory and darkroom. (Imperial Ship Company)*

Collegiate Rebels Go to Sea

By H. A. MILLER
Miami University, Oxford, Ohio
AND
W. H. STUART, JR.
Bartow, Florida

EDITOR'S NOTE: Yachtsmen and angler members frequently write to say that they are about to begin an extended cruise and would like to assist oceanographic institutions by making collections or observations while at sea. In order to take advantage of such offers it is necessary, however, to plan well in advance. Members planning to make such cruises and desirous of cooperating in this fashion should therefore make early contact with an oceanographic laboratory or museum. The Foundation Secretary will be glad to give the addresses of such institutions upon request.

Meanwhile we are glad to print the following brief account of an expedition sponsored by a group of students who wish to augment their college training by firsthand experience in scientific collecting at sea. Those who would like to know more about this round-the-world cruise should write to Collegiate Rebel Association, Box 209, Bartow, Florida.

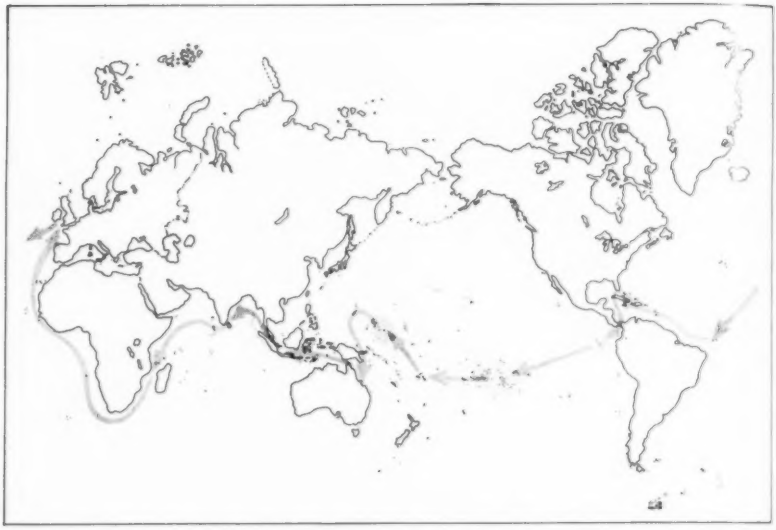
TOWARD the end of January, 1960, the schooner *Collegiate Rebel* sailed out of Tampa Bay on a two-year round-the-world cruise. Despite the fact that this cruise is not sponsored by generous grants or agencies, the purpose of the voyage is essentially educational and scientific. And, it marks the realization of a two-year dream of a small group of Washington State University students.

It all started over a late evening snack, when the conversation inevitably turned to life after college. Someone suggested sailing around the world in search of education in the form of first-hand experience. It was further decided that regular seminars could be held on board and that invitations should be extended to scientists and specialists in all fields to join the cruise, whenever and wherever possible, on a share-the-cost, share-the-knowledge basis. Thus, the Collegiate Rebel Association, a nonprofit, educational and scientific corporation was born.

First Requirement—A Ship

The Association managed to induce friends to purchase a suitable vessel, and to establish the Imperial Ship Company, Inc. Then the Association chartered the schooner, which was christened the *Collegiate Rebel.*

The ship has a steel hull and mainmast, is 107 feet long (87 feet at water line), and has a 21-foot beam amidships. Auxiliary power consists of a 160 h.p. Buda diesel and a 70 h.p. Buda diesel for the 110 volt D.C. electrical system. She carries modern navigational equipment except for radar and loran. Commodious facili-



AROUND THE WORLD *for science and research. The map shows the tentative itinerary of the good ship* Collegiate Rebel, *which offers to make collections along any or all parts of its earth-circling cruise. Principal research areas in Polynesia and Micronesia are shaded. (T. J. Cobbe)*

ties are available for eighteen persons and, in addition, the forward compartment has been converted into a well-equipped biological laboratory and darkroom. In order to assist in underwater exploration in the vicinity of islands and reefs, professional skin-diving equipment is provided.

Flexible Itinerary

Although the itinerary is flexible, the ship will visit the Galapagos Islands, en route to the islands of Southern Polynesia. Stops are planned at Hiuaoa, various islands in the Tuamotu group, Tahiti, Cook Islands, Samoa and Fiji. From Southern Polynesia the voyagers will go to Micronesia for the summer months. Major stops will be made at Ponape, Kusai, Truk, and Yap, in the Caroline archipelago and the Palau Islands.

August will find the *Collegiate Rebel* under sail toward Guam and the Mariana Islands, before heading south to Borneo, Australia, India, and friendly lands in between and beyond.

While in the Polynesian Islands, mosses and liverworts will be collected for study by the senior author. A National Science Foundation grant (G-7115) to Miami University, Oxford, Ohio, had made it possible for a research assistant in botany to participate as a member of the Association. In June, the senior author will join the Association in Micronesia for field studies.

In addition to botanical work, the staff of the *Collegiate Rebel* will collect other materials on request from or in cooperation with specialists. Currently, they will collect molluscs for Dr. R. Tucker Abbott, Pilsbry Chair of Malacology, Academy of Natural Sciences, Philadelphia; bird specimens for a muscle study for Dr. George E. Hudson, curator, Charles E. Conner Museum, Washington State University, Pullman, Washington; and octopus and squid for Dr. Gilbert L. Voss, curator at The Marine Laboratory, University of Miami, Coral Gables.

Other studies, many of which are to be used for advanced degree work, include: porpoise, dolphins, their weights, measurements, and behavior patterns; Indo-Pacific entomology; nutritional effects on teeth formation; breed characters influencing adaptability in Brahman type cattle; international commerce, practices and law.

Each of these studies has been prepared with the advice and counsel of men competent and known for their work in their respective fields.

I.O.F. Members Welcome

As the principal goal is to be useful in the advancement of knowledge, the Association solicits requests for assistance from interested individuals or institutions. Whenever possible, material support would be much appreciated. Wherever she stops, the *Collegiate Rebel* welcomes members and friends of the International Oceanographic Foundation to come aboard for a visit and a chat.

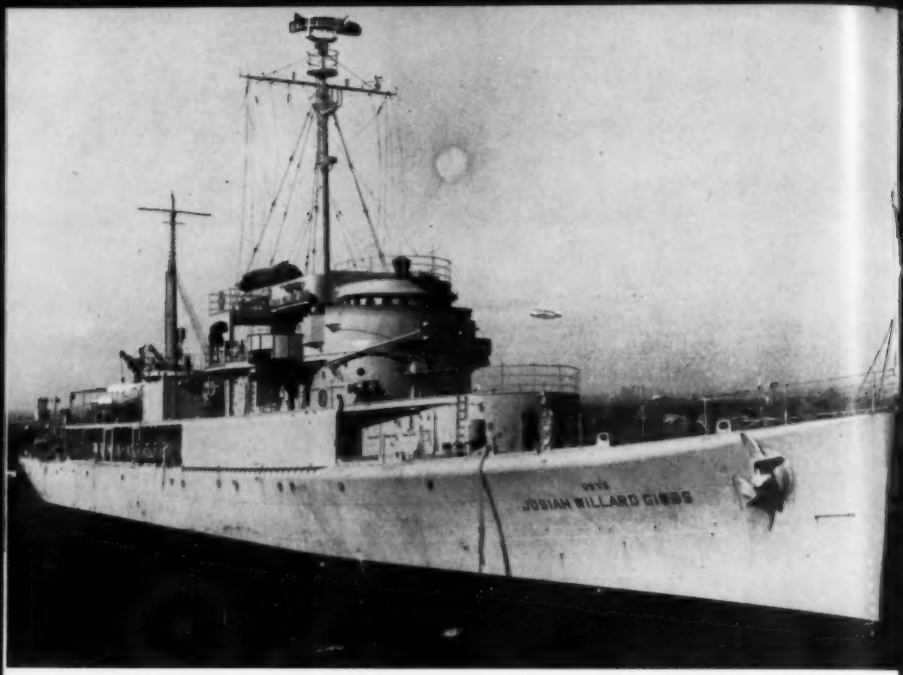
Fighting Water With Water

One of the newer problems along the sea frontier is the sinking of waterfronts due to subsiding oil-drained areas beneath. This causes water flooding.

Long Beach, California, Goose Creek, Texas, and Lake Maracaibo, Venezuela, all have been bothered with this difficulty. At Long Beach Harbor, the land sank twenty-six feet in twenty years and was becoming a billion-dollar threat to a United States Navy base, oil companies, and piers, bridges and pipelines of the city.

Now port engineers believe they have arrested Long Beach's "sinking feeling" by the stratagem of fighting water with water. After millions of gallons of water were pumped back into the caving subsoil, subsiding ceased. In short, engineers contend, the Long Beach Harbor District eventually will be successfully refloated, water replacing drained-off oil deposits. Plans call for 268 injection wells, pumping a total of 1,000,000 barrels of water daily into the substrata.

Injection water, however, moves oil, and some oil producing areas may be flooded and lost. To insure against suits, a complex legal arrangement was set up to provide that all oil produced and the cost of water injections would be equitably shared by the 115 operators in the area.



LARGEST AND BEST EQUIPPED *oceanographic research vessel flying the Stars and Stripes, the* U.S.N.S. Gibbs *was converted from the former seaplane tender,* U.S.S. San Carlos. *Displacing 2,800 tons, and with a maximum speed of 18 knots, this trim ship has accommodations for a crew of forty-eight, plus twenty-eight scientists. It is capable of making extensive studies of the physics of the ocean, with emphasis on exploration of submarine sounds. (U. S. Navy photo)*

Research Ship Visits Miami

MARINE SCIENTISTS of the Miami area had a chance to inspect the splendid facilities of the 2,800-ton oceanographic survey vessel, U.S.N.S. *Josiah Willard Gibbs,* in December, 1959, when the *Gibbs* docked there briefly between two trips to the Tongue of the Ocean, in the Bahamas.

On the first voyage the *Gibbs* carried members of the U.S. Navy Undersea Warfare Research and Development Planning Council, who conducted a three-day meeting in its wardroom. At the end of this period, the *Gibbs* returned to Miami and embarked scientists from the Hudson Laboratories of Columbia University, the U.S. Navy Hydrographic Office, and the David Taylor Model Basin. During this second trip, in addition to oceanographic studies, the *Gibbs* conducted tests on new experimental equipment.

Can Probe Greatest Depths

Newest and largest of oceanographic research ships flying the Stars and Stripes, the *Gibbs* is capable of probing the deepest parts of the oceans of the world. Exploration of new anti-

submarine warfare techniques also benefited since the ship was placed in operation by the Navy on December 18, 1958, at Mobile, Alabama, where it was converted from the former seaplane tender, U.S.S. *San Carlos*.

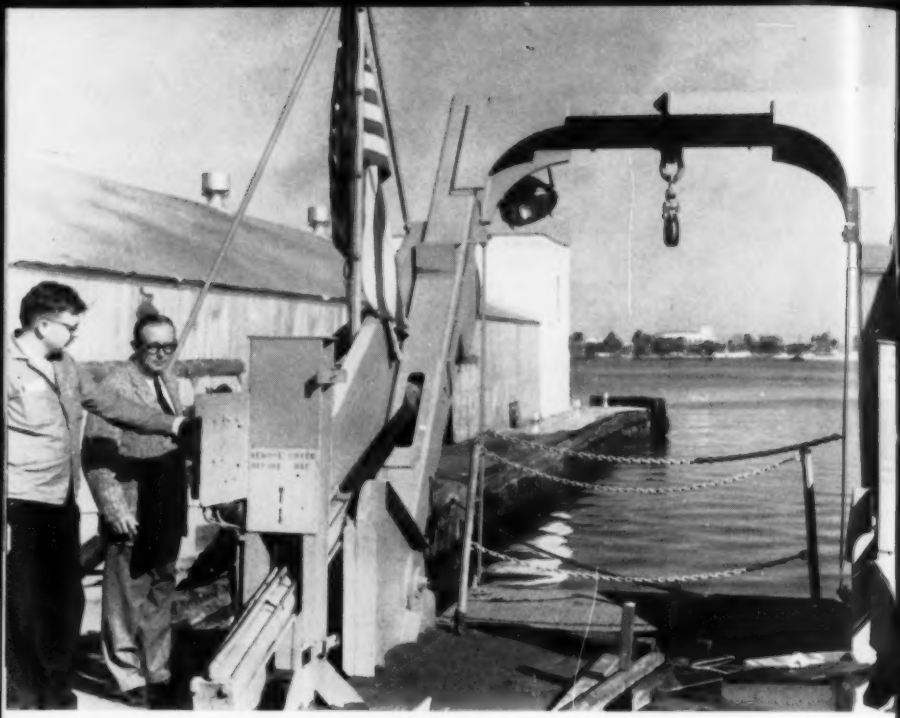
Owned by the U.S. Government, the *Gibbs* is operated for the Office of Naval Research by the Military Sea Transportation Service and is manned by civil service marine personnel. It is 310 feet long, has a maximum speed of eighteen knots, and can accommodate a crew of forty-eight plus twenty-eight scientists.

More Space for Research

The large size of the *Gibbs* permits far more space for research and other scientific activities than on any previous American research ship. Several large laboratories aboard are equipped with a great deal of instrumentation. In addition, the ship can handle heavier weights at greater depths and provide greater stability for delicate scientific measurements than any other oceanographic research vessel now in operation by the United States.

Probably the most impressive piece of equipment on board the *Gibbs* is a king-size winch, described by the Office of Naval Research as the largest and heaviest deep-sea winch ever used in the United States for oceano-

SCIENTISTS HOLD INFORMAL *conference on the* GIBBS, *during her visit to Miami, Florida. Left to right, Mr. Rolf Anderson and Mr. Gerald Fisher, of the Hudson Laboratories, Columbia University; Captain Warren Olivey, master of the* GIBBS; *Dr. F. F. Koczy, Dr. F. G. Walton Smith, and Dr. H. B. Moore, the latter three from The Marine Laboratory, University of Miami.*



A UNIQUE FEATURE *of the* Gibbs *is a strong hydraulic gallows or U-frame, for handling heavy gear over the stern. It has a capacity of 30,000 pounds. Mr. Rolf Anderson, left, of Hudson Laboratories, demonstrates its operation to visiting Dr. F. G. Walton Smith, Editor of* SEA FRONTIERS.

graphic purposes. It is capable of handling up to 40,000 feet of wire rope, and of lowering and raising as much as 20 tons of equipment.

The *Gibbs*, which has been assigned to the Hudson Laboratories of Columbia University, is devoted primarily to research in the physics of the ocean—a most appropriate work considering that its namesake, Professor Josiah Willard Gibbs, was a distinguished physicist at Yale University. His work, almost entirely concerned with the purest of theoretical science, resulted in some of the chief contributions to mankind's fundamental knowledge in the physical sciences. Two of his students won Nobel Prizes following up his original research.

Fish Are Bothered by Them, Too

By BERNARD L. GORDON
Rhode Island College

PARASITES, or forms of life which exist at the expense of other forms of life, have long afflicted man, land animals and plants. Diseases and suffering caused by their nefarious activities have been a vexing and continuous challenge to medical science.

It is not so well known that marine life may be bothered with them, too. In fact, most fishes are infested to some extent with various kinds of parasites, which can be either harmless or may cause both discomfort and serious injury. Some of these organisms are tiny, even microscopic; others are big, and fantastic in their appearance and the manners in which they prey upon their hosts.

Giant Female; Dwarf Male

Take, for instance, a unique case of parasitism among members of the deep sea anglerfishes. The curiosity of marine biologists was aroused when apparently only the females of this species were captured. Where were the males? Finally it was discovered that the males were dwarfs, and spent the greater part of their lives as parasites on the female.

A fish taken near Iceland was forty inches long, and the attached male only about four inches. The female was judged to be one thousand times the weight of her mate. This remarkable relationship seems to have developed as a result of the fish's strange environment. Living in the black abyssal depths of the sea, and being sluggish and solitary in its habits, the chances of a mature fish finding a mate of its own species would be very small.

A Quick Attachment

This situation is overcome by the male anglerfish's instinctive pattern of behavior. Perhaps while still young, it seeks a female and becomes permanently attached. The site of attachment appears to be a random choice, sometimes on the abdomen, the sides, the head or even on the gill cover.

Occasionally a female anglerfish will be found with two or three male parasites attached. The male grips the female with his strong teeth, and his lips and tongue grow into her skin. Degeneration takes place in the male's mouth, jaws, teeth, fins and gills. Only his reproductive system remains active. The two blood systems become fused and the male is nourished by the blood of the female.

Temporary Guests

Some forms of marine life, however, are parasitic only during certain stages. The larval form of fresh water mussels and clams, *Anodonta* and *Unio,* for example, spend three to twelve weeks attached to the gills or fins of various fishes. They are called *glochidia* and are nature's way of insuring distribution of these species from one stream to another and even upstream against the currents, carried

THE DEEP SEA ANGLERFISH, *from the Gulf of Panama, bears a "lamp" on the nose. A dwarf parasitic male may be seen attached to this female horror on the lower rear surface.* (GALATHEA *Deep Sea Expedition)*

by the swift moving fish.

The sleek little pearl fish, *Carapus,* lives within the body of certain holothurians, or "sea cucumbers" (distant relatives of the starfish), passing in and out by way of the anus. A small goby has been found cuddled up comfortably in the gill chamber of the shad.

Commensalism, a Nice Arrangement

The little scorpion fish of southeast Asia, and a species of hydroid polyp, a sedentary relative of the jellyfish, represent commensalism, an example of a nice relationship which benefits both partners. Much of the fish is covered with the thick fleshy polyps. In fact they have never been found apart from the fish. This encrusting polyp growth conceals the fish from its enemies by giving it the appearance of a weed-covered rock, while the hydroid colony gets free transportation to new feeding grounds by the fish.

Another example of commensalism, in which neither party to the relationship is harmed, is the attachment of the pilot fish or remora to sharks and sting rays. These shark suckers also enter the mouths and gill-cavities of large bony hosts, such as the sword-

TWO SETS OF TEETH *make the sea lam prey a difficult fellow to shake off. Th oral disk or outer teeth is used to hol on grimly; the inner or tongue teeth di a hole in the host. Scientists say th lamprey has been somewhat over-ma ligned as an actual killer of fish, bu there can be no denying that the scars leaves on those which survive lampre parasitism lower the market price. (U.S Fish & Wildlife Service)*

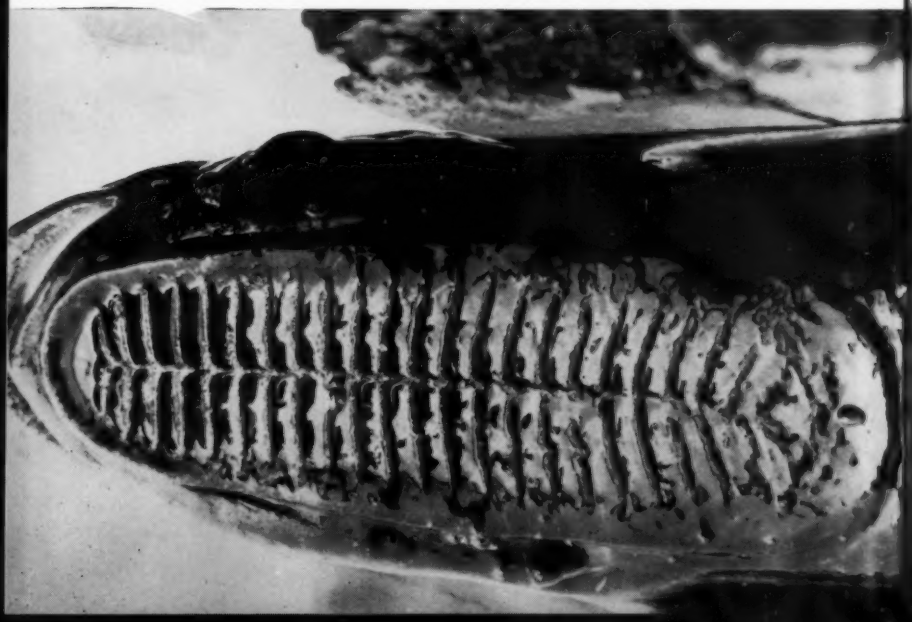
fish, sailfish and ocean sunfish, doing no injury but gaining protection from their enemies, scraps of food, and transport.

It was formerly thought that the hagfish was a true parasite because it was frequently found inside the body cavities of cod, haddock, and hake. It is now believed that it is a scavenger, attacking only injured or dying fish. Being blind, it finds its food with its highly developed sense of smell. It is best known for its damaging habits of boring into the body cavities of hooked or gilled fishes, eating out the intestines first and then the meat.

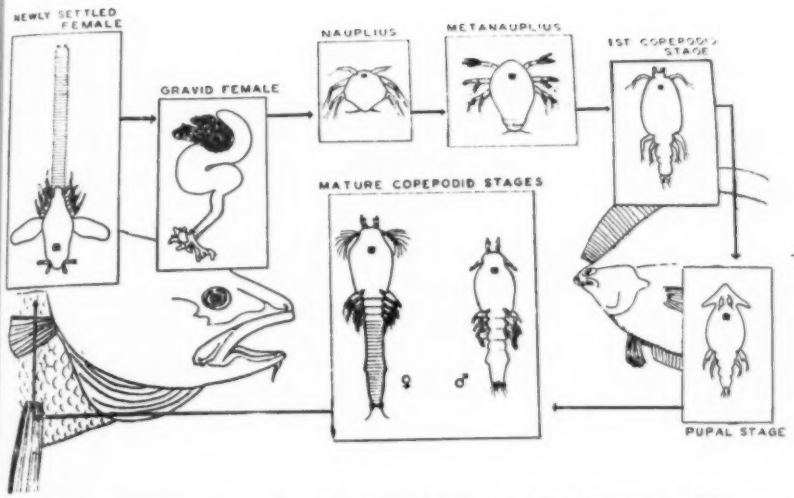
"Fish Lice" in Cod

One of the most familiar of all fish parasites is the copepod, better known as "fish louse," found embedded externally or internally in such species as swordfish, oceanic sunfish, and cod.

During the last three years the U.S. Fish and Wildlife Service has carried out an extensive research program on a copepod parasite of the codfish. This copepod, *Lernaeocera branchialis,* is usually found in the gill filaments of the fish. The level of infestation of cod in New England waters varied from over thirty per cent in one location to less than one per cent in another area. An extra dividend from this study is the evidence it gives of the presence of several distinct stocks of cod off the northeast Atlantic coast.



NATURE'S ORIGINAL NON-SKID. *By this suction cup on its head, the pilot fish, or remora, attaches itself to sharks, sting rays, and other large sea creatures. The remora is not a true parasite, doing no injury to its host and sometimes removing harmful growths. Hitch-hiking with larger animals, the remora gains not only protection from its enemies, but also scraps of food, and free transport. (Photo from author)*



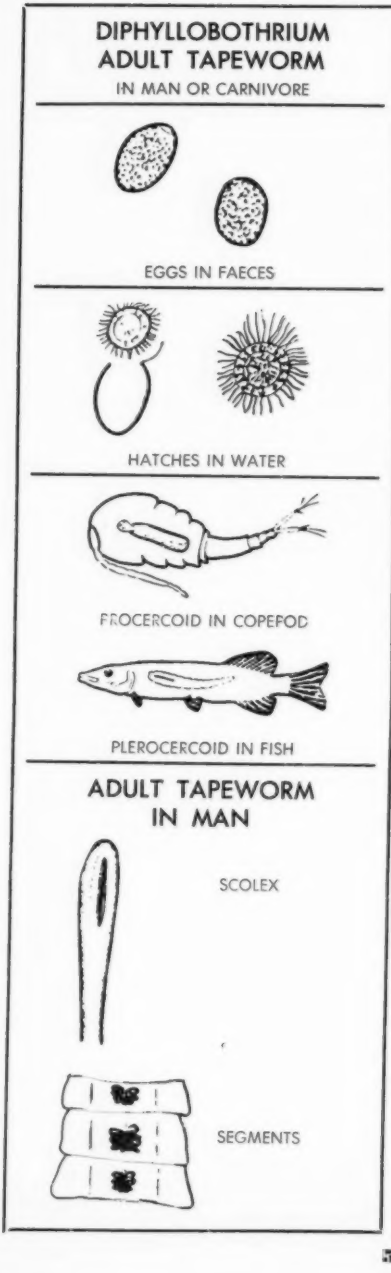
FISH "LOUSE" OR COPEPOD, *one of the most familiar and troublesome of fish parasites. It embeds itself externally or internally in swordfish, oceanic sunfish, flounder, cod, etc. This drawing shows the odd and varied sequence of its weird life cycle, reading from upper left to lower right, and finally center. (Drawing from author)*

Another group of crustaceans, the isopods, related to pillbugs or woodlice, also are common parasites on tropical reef fishes, even adopting their host's color. Some reach a large size, attached beneath the eye or near the mouth. Still others, reported from jacks, mackerel and their allies, are found in the mouth cavity. A single female, equipped with powerful hooks, may be found lying on the tongue, head outward, often so large that the fish no longer can close its mouth. A male or two, much smaller, is usually found to the rear, conveniently attached to the bone of one of the gills.

Gill Cavity Home

A most unusual parasitic fish occurs in the waters of Brazil where it is called by natives "carnero." It habitually lives within the gill cavaties of large catfishes where its slender form enables it to penetrate between the gills. Using its sharp teeth and opercular spines it starts a flow of blood from its host which is sucked up by the mouth.

In some parts of Brazil the "carnero" is very much dreaded by the natives, owing to its unpleasant habit of entering the genitals of persons bathing in rivers. Both men and women are in the habit of wearing special sheaths of palm fibers to protect themselves when obliged to enter the water. The little fish appears to be definitely attracted by urine. Some authorities believe that the flow of urine is mistaken by the fish for the respiratory current coming from the gill opening of a fish.



An accident of this nature to a human may have serious consequences, for once the fish has entered, it cannot always be pulled out, as it possesses erectile spines. A prompt surgical operation is necessary to prevent it from reaching the bladder and causing death from inflammation.

Fish Tapeworm Menaces Man

Among the best known of the fish parasites is the broad fish tapeworm, *Diphyllobothrium latum*. N. R. Stoll in 1947 estimated that about ten million people in the world are infected by it. This parasitic worm spends the last larval stage of its development in pike and other fresh water fishes. The infected fish obtained the parasite by swallowing "water fleas" such as *Cyclops* or *Diaptomus,* which contained the larva of the worm. The larval tapeworm is generally found in the viscera and muscles of the fish.

Cooking usually destroys the parasite, but in parts of Europe, North America and Japan the fish sometimes is eaten smoked, or in an inadequately cooked state, and the worm will continue its growth in a human host.

The fish tapeworm is the largest species of tapeworm found in man.

UNLESS PIKE AND CERTAIN *other freshwater fishes are thoroughly cooked, man in eating them becomes infected with this parasite of a formidable name. The broad fish tapeworm is the largest species of tapeworm found in humans, at times attaining the incredible length of 20 to 30 feet! It can be responsible for a severe type of anaemia. Fortunately such parasites are rare in sea fishes.* (The Parasites of Man *by William Cameron. Toronto, 1940)*

ORANGE FILEFISHES *are shown being measured by the author in his laboratory at Rhode Island College. Mr. Gordon has made a study of marine fish found in New England waters, including the little-known parasites they host and which present vexing problems for both commercial fishermen and scientists. (Photo from author)*

It reaches an adult length of twenty to thirty-three feet. This tapeworm can live for twenty years or more in a man and is responsible for a severe type of anaemia. Man is not the only host of this fish parasite, it is also found in bear, mink, fox, otter and other carnivorous mammals.

It is strange to note that another species of fish tapeworm, *Ligula,* is considered a gourmet's delight. This Cestode worm, which may reach a length of fifteen to twenty inches, lies free in the body cavity of the infected fish. In Italy and southern France this fish parasite is considered a tasty delicacy and is prepared under the names of *maccaroni piatti* and *ver blanc.*

Arctic Weak in Plant Plankton

Marine biology studies at the IGY Drifting Station Bravo show that the Arctic Ocean, while comprising 1/23 the area of all the earth's oceans, contributes only about 1/0000 the total oceanic production of plant plankton, a basic food for forms of larger marine life.

Science of the Sea in BOOKS

General Reading

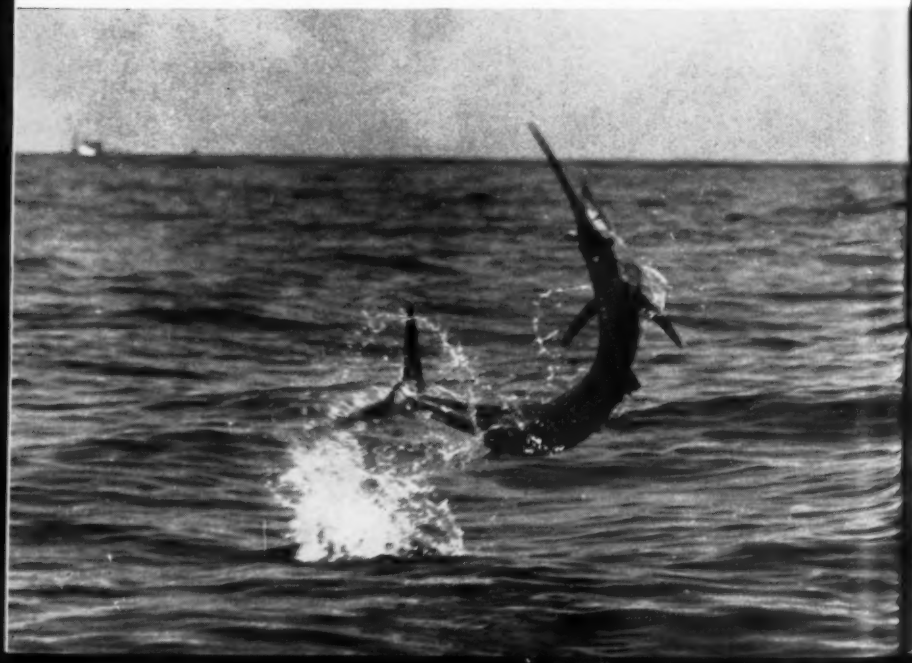
NATURE PARADE

FRANK W. LANE. Jarrolds Publishers, Ltd. London. 1955. 288 pp., 48 plates. 18 shillings.

There are many writers on natural history but few have the ability to unearth as many and as obscure facts and interesting anecdotes about the teeming life of Mother Earth as does Frank W. Lane. The present book is no exception and both the general reader and the scientist will find here many absorbing and fascinating hours of reading.

For readers interested in the sea there is a special chapter devoted to fishes, but such is the general make up of the book that marine subjects will be found under nearly every heading. Mr. Lane obviously has been intrigued with fish methods of swimming, production of electrical currents in various fishes, and the speed attained by marine animals when putting their best fin forward.

Page 159 contains a Speed Table, with the estimated speeds of forty-three aquatic animals, from shrimp which travel at 0.25 miles per hour to the sailfish with an estimated speed of 68 miles per hour. Invaluable is a col-



HOW FAST DO FISHES MOVE? *In* Nature Parade *(reviewed above) author Frank W. Lane estimates the speed of forty-three aquatic animals, from shrimp, which swim at a mere 0.25 miles per hour, to the sailfish, dubiously reported to travel up to more than a mile a minute. Here a sailfish shows its power, after striking the bait at terrific speed. (John Mahony)*

umn devoted to the methods of obtaining these measurements.

While some marine observers may be in agreement with these speeds, many will object that the speeds given are far too high in some cases. For instance, this reviewer has studied the sailfish for many years and feels that an actual speed of 20-25 miles per hour would be far more reasonable. Even 44 miles per hour for the bluefin tuna seems excessive from experiences with these fishes off Gun Cay during the annual migration. The porpoise is listed at 37 miles per hour, a more conservative figure than the 60 miles per hour often claimed.

If a general criticism can be made of the volume, it probably would be that the wealth of information contained often has little connection, and the overall effect is one of a jumbled mass of data and anecdotes piled helter skelter under broad headings. The index, however, aids in separating facts needed for reference, and is very extensive. Frank Lane is now completely revising the present edition and we can look forward to even more fascinating tidbits of information on our animal friends. The present volume is profusely ilustrated with startling and often unique photographs. G. L. V.

SATELLITE OF THE SUN

ATHELSTAN SPILHAUS. Viking Press. New York, 1958. 119 pages. $3.50. If you have been intrigued by geophysics—the physics of the earth—and have wondered how you might know something about it without getting in too deep, this book is tailored for you. In simple, lucid prose, Dr. Spilhaus, Dean of the Institute of Technology at the University of Minnesota, deals with "the bulk of the earth, from the rocky substance on the surface down to the hot liquid metal center"; with the sea water that covers most of the planet; with the air we breathe and fly in; and the region beyond the atmosphere.

Oceanographers will find that about a fourth of the text deals with subjects related to the sea, and the role the oceans play in food changes in the weather, trade, etc. today, or will play tomorrow in meeting our growing need for the sea's largess. While much of the information is not new, it is freshly presented, and it pulls together many of the findings of the International Geophysical Year.

Dr. Spilhaus was an early advocate of many ideas now accepted, such as weather control, automatic weather-forecasting, and global weather networks. He believes that geophysics by its very nature must be global, and therefore international, and has worked with committees on the Geophysical Year, and the international study of marine sciences. E.J.L.

Technical Reading

PRINCIPLES OF GEOCHEMISTRY

BRIAN MASON. John Wiley & Sons, Inc. 2nd edition. New York, 1958. 310 pages. $8.50.

The last decade has been the most productive period in both geochemistry and cosmochemistry. The most comprehensive books in the field of geochemistry were edited during this time. It was mainly the imaginative mind of V. M. Goldschmidt, working in Oslo and Göttingen, which created the science of Geochemistry. His school and his students established the basis on which the general laws governing the distribution of elements have been formed, dealing primarily with the structure of inorganic compounds and their changes as interpreted by the principles of chemical equilibrium. V. I. Vernadsky and his school showed the important effects of the life processes, on the earth and in the sea, on the distribution and migration of the elements in soils and sediments.

Of all the reference books in geochemistry, the first edition of *Principles of Geochemistry* was the only one which could easily be used as a textbook. The advance in geochemistry during the last years is clearly demonstrated by the fact that a new edition was found to be necessary after only six years. Many chapters have been revised, considering the progress in concepts and theories, and much has been added.

The first chapters deal with basic principles and with background material for the logical exposition of the processes, at and near the surface of the earth, which determine the distribution of elements. The earth is discussed as a part of the universe with special consideration of its origin and age. In a later chapter, the structure of the earth and its composition are described together with the theories of pre-geological history.

The nucleus of the geochemical theories, the thermodynamics of the transformation of matter from one state to another, i.e., crystallization, oxidation and reduction, weathering, formation of minerals, solid state chemistry are discussed in an excellent chapter. The application of thermodynamics to the problem of stability and to the equilibrium of the polyphase system is demonstrated.

Geochemical processes are discussed with respect to the reservoirs of elements and to their origins. Magmatism, the igneous and sedimentary rocks, the hydrosphere, the atmosphere, and the biosphere are dealt with and rock metamorphism, which was the starting point for modern geochemistry, is discussed in a special chapter. The last chapter, on the geochemical cycle, is rather short and incomplete.

The book is excellently written and concise. It is certainly the textbook *par preference* for a course in geochemistry, instructive for the students and stimulating to the workers in the field. The references cited cover the field completely with one exception: the German book, *Die Entstehung der Gesteine* by Barth, Correns, and Eskola, which in content covers about a half of the *Principles in Geochemistry* and in concept is very similar, has not been mentioned anywhere. Perhaps a translation is necessary.

F. F. K.

UNDERWATER WORK

JOHN E. CAYFORD. Cornell Maritime Press, Cambridge, Md. 232 pages. $5.00.

The versatility of SCUBA (self-contained underwater breathing apparatus) is clearly demonstrated in this manual of commercial, salvage and construction diving. SCUBA diving itself in oceanographic research is summarized very briefly at the end.

The author writes convincingly about his experience with underwater salvage, construction and repairs, pipelaying, cutting and welding, demolition, logging and photography. In addition to falling in the obvious category of "a standard reference work" on these subjects, the book should stimulate creative thinking on the part of all who do underwater work, marine scientists included. For instance, on pages 141-146, underwater lights are discussed. The author presents six figures; the text outlines what materials are needed, where obtainable, and so forth. If an underwater light is needed for any purpose, Cayford's ideas either solve the problem or indicate steps to a solution.

The same can be said for a wooden underwater camera housing (p. 150), methods of search for underwater objects (p. 24), how to build a small wharf (p. 38), explosives suitable for underwater work (p. 101), etc.

In short, this book summarizes the accumulated practical knowledge of an experienced commercial SCUBA diver. It is utilitarian, well illustrated, clearly written, and can answer many vexing new questions.

K. McN.

About the Authors

ROSS LEFFLER

Before assuming his present position as the first Assistant Secretary of the Interior for Fish and Wildlife, Mr. Leffler had a long and creditable record as conservationist and official of many outdoors and sportsmen's organizations. Mr. Leffler is a former national director of the Izaak Walton League and a past president of the International Association of Game, Fish and Conservation Commissions.

Born in Butte, Montana, Mr. Leffler reversed Horace Greeley's advice ("Go West, Young Man") when his family moved to Boston, Mass. He later attended the University of Michigan. Starting in the steel business, with Carnegie Steel Corporation at Duquesne, Pa., Mr. Leffler later became a member of the Pennsylvania Game Commission. Here he served 29 years, 16 of them as its president. His association with the Department of Interior dates from 1954, when he was a member of a survey team which made a thorough study of the Fish and Wildlife Service of the Department.

DAVID BARKER

An Oxford zoologist, Dr. Barker was appointed to the Chair of Zoology at the University of Hong Kong in 1950, at the comparatively young age of twenty-eight. He both planned and put into operation the Fisheries Research Unit as part of his department in 1952, and helped to build it into the flourishing organization it is today. Dr. Barker is also founder and editor of the *Hong Kong University Fisheries Journal,* in 1954.

In addition, Dr. Barker was leader of a scientific expedition to an oasis in Southern Tunisia in 1950, and an island off North Borneo in 1952. His research interests lie in the field of neurology. He is an authority on muscle-receptors and has a small but productive team working with him in this field.

F. D. OMMANNEY

Dr. Ommanney came to Hong Kong, where he is director of the Fisheries Research Unit and Reader in Marine Biology at the University of Hong Kong, via the Antarctic and Indian Oceans. For ten years he was a member of the staff of the British *Discovery* investigations of the natural history of Antarctic whales, spending two whaling seasons in South Georgia and one at Durban, South Africa, in addition to voyages in the Royal Research Ship *Discovery II*. For these services he was awarded the Polar medal (Bronze) in 1942.

Following six years in the Royal Navy during World War II, Dr. Ommanney collaborated with Dr. J. F. G. Wheeler in a survey of Indian Ocean fishes, and in 1952 was appointed Director of the Regional Fisheries Research Station, Singapore. When this station closed in 1957, Dr. Ommanney came to Hong Kong. He is the author of several scientific papers on whales and plankton, as well as number of popular travel books, best known of which, *South Latitude*, was a best seller in 1938.

BERNARD L. GORDON

Mr. Gordon has combined two interesting careers—that of an instructor in biology at Rhode Island College, in Providence, with success as a free lance writer and photographer. His most important work in marine biology was a survey of all the species of marine fish found in Rhode Island waters, the subject of his Master of Science degree in Zoology at the University of Rhode Island. Mr. Gordon also presented a paper on this topic at the annual meeting of the American Association for the Advancement of Science, in Washington, D. C., in 1958.

His articles and photographs have appeared in *Natural History*, *Nature Magazine*, *Outdoor Life*, *Fishing World*, *The Fisherman*, the Philadelphia Academy of Natural Science's *Frontiers*, and other publications. Currently Mr. Gordon is finishing a book, *Populace of the Sea*, dealing with marine organisms.

Brotherhood of Green Turtle

Is the green turtle, the sea giant which supplied fresh meat for Spanish galleons, early colonists in the Caribbean area, buccaneers, and merchantmen, going the way of the passenger pigeon, the great auk, and the heath hen? Not if a group of business men, gourmets and conservationists can prevent it. They have organized a noncommercial club called the Brotherhood of the Green Turtle, which was instrumental in the formation of a more practical unit, the Caribbean Conservation Association.

The Association is taking 12,500 green turtle eggs from a Costa Rican turtle nursery and reintroducing them in various parts of the Caribbean and Florida in an attempt to save the species.

John Oliver La Gorce

The Board of Trustees of The International Oceanographic Foundation reports with profound regret the death of Dr. John Oliver La Gorce in Washington, D.C., December 23, 1959. A pioneer member of the Board of Trustees of the Foundation, Dr. La Gorce gave freely of his advice and counsel during the Foundation's formative years, and has been active in directing the attention of his wide circle of friends and associates to the publications and scientific research of the Foundation ever since its incorporation in 1953.

For more than fifty years Dr. La Gorce was associated with the National Geographic Society and its publications, during which period he contributed many authoritative writings on the sea and sea life, including the Society's popular *Book of Fishes*, and such articles as "Devil Fishing in the Gulf Stream," "Food Fish of the North Atlantic," "The Warfare on Our Eastern Coast," "Battle at the Tide Line," etc.

Miami members will recall that he was among the first to recognize the possibilities of Miami Beach as a year-around seaside and fishing resort where summers and winters were tempered by constant breezes from the mighty Gulf Stream. Appropriately enough for a man whose interests and enthusiasms turned so often to the sea, an island in Biscayne Bay now bears his name. In addition to his encouragement of the scientific activities of the Foundation, Dr. La Gorce was also an active member (since 1944) of the Board of Trustees of the University of Miami, a Fellow of the Royal Geographic Society of England, and a Chevalier of the French Legion of Honor.

Dr. La Gorce will be deeply missed by his many friends and associates, not only as one who served geography, marine science and education well during a long and rich career, but also as a man who had a rare talent for friendship in all walks of life.

Progress

DURING THE FEW YEARS of its existence *Sea Frontiers* has reached a membership which has more than doubled every twelve months. Members are drawn from the United States, Canada, Central and South America, Great Britain, Australia, France, Germany, Italy, Turkey, Denmark, Sweden and Norway as well as a few from the Pacific Islands, the West Indies and Russia.

CONTINUED IMPROVEMENT will be possible with growth of active membership. It will be seen in better service, with more articles in the magazine of high interest and authenticity and, eventually, a monthly issue in full color.

IN ADDITION TO PUBLISHING *Sea Frontiers* and *Sea Secrets*, the Foundation provides active support for scientific research and education. The ocean is our last frontier and its exploration still under way.

MEMBERS are joined in these aims and they are urged to make progress possible by taking the small effort needed to enlist new members. Sample copies will be mailed to friends upon requst.

INVITATION: Those who are not members, but whose interest and curiosity lie in the sea and the spirit of discovery, may participate by simply mailing the card in this issue.

THE EDITOR will be glad to consider for publication articles and illustrations covering explorations, discoveries or advances in our knowledge of the marine sciences or describing the activities of oceanographic laboratories or expeditions in any part of the world.

The International Oceanographic Foundation

"To encourage the extension of human knowledge by scientific study and exploration of the oceans in all their aspects, including the study of game fishes, food fishes, ocean currents, the geology, chemistry, and physics of the sea and the sea floor."

MEMBERSHIP

The Foundation was established by a group of saltwater anglers, yachtsmen, shipowners, marine scientists and others interested in the scientific exploration of our last frontier, the ocean. Its objectives are to provide support and encouragement for marine research, exploration and discovery and to promote the collection and dissemination of scientific knowledge about the ocean.

Qualifications for membership are an interest in the oceans and a desire to extend and develop scientific research and exploration into them. Support given to research through personal activities or donations is recognized by the Foundation through the following classes of membership. Members are those who make annual contributions of $5, Fellows $25 annually; Associates $100 annually; Life Fellows are those who contribute $200 or more or who have otherwise helped to advance the purposes of the Foundation; Sponsors who contribute $1,000 or more; and Patrons who contribute $5,000 or more. Corporate Associates contribute $1,000 annually.

According to a ruling of the U.S. Treasury Department, donations made to the Foundation are deductible in computing taxable income as provided for by the 1954 code.

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PRINTED BY PARKER, CORAL GABLES, FLORIDA, U.S.A.